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DEPARTMENT OF NATURAL RESOURCES
WARREN T. HANNUM, DIRECTOR
DIVISION OF MINES
OLAF P. JENKINS, CHIEF

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MINERAL INFORMATION SERVICE

Vol. 1 February 1, 1948 Nos. 1 and 2

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications.

This pamphlet takes the place of previous news releases, Information Circulars, etc., and is distributed without cost upon request.

It has been called to our attention that there is no statutory authority for this state agency to publish want ads or for sale notices (formerly released as "Commercial Mineral Notes"). Therefore we are discontinuing this service.

Notes on Current Mining Activity in California

Amador County

A plant has been erected at the Buena Vista lignite mine five miles south of Ione. Experimental work has been carried on for some time in preparation for commercial production of montan wax, mineral pigments, and briquettes which will be produced from the lignite found in this vicinity and near Ione. The De Angelis Coal Company, Carbondale, Pa., expects to begin regular operation of this plant early in 1948. They plan to treat 200 tons daily. Vincenzo De Angelis is president, James N. DeAngelis is superintendent, and R. L. Drew is the technical engineer. Eight men are now employed at this property.

Mariposa County

A six-man crew under the supervision of J. H. A. Williams is driving a 200-foot tunnel to the Evans and French mine near Bagby. This is a gold property.

Mendocino County

A portion of the coal has been stripped for mining by an open cut at a coal deposit 6½ miles northeast of Dos Rios. E. J. Thorpe of Stockton and associates have built 1-3/10 miles of access road from the Covello highway to the coal deposit. Two Dos Rios contractors, J. Creson and L. Girsch, have three men employed with a Lima power shovel, Mississippi wagons, and bulldozers placing gravel on the road.

Nevada County

Twenty sets of lessees are working at the gold properties of the Empire Star Mines, Ltd., near Grass Valley. H. Fitzpatrick is in charge of this work.

A crew of 280 men are employed at the gold properties of the Idaho Maryland mine near Grass Valley. Neil O'Donnell is in charge of the work.

A crew of 25 men are mining newly developed ore on the gold property of the Spring Hill mine near Grass Valley. C. C. Cushwa is supervising these operations.

Gold mining was suspended at the Gaston mine late in December when all but three men were paid off. This mine had been operated since September 1947 when the Tonopah Divide Mining Company, E. L. Cleveland, general manager, Reno, Nevada, began milling the ore with an old 10-stamp mill.

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Shasta County

About 700 tons of pyrite is mined daily at the property of the Mountain Copper Co., Ltd., 216 Pine St., San Francisco. L. T. Kett is general manager of the company and J. L. Huseby is assistant general manager. The pyrite is hauled to the railroad with trucks while repairs are being made on the tram line to the railroad. The company employs 120 men operating on two shifts with C. W. McClung, superintendent, and T. P. Bagley, mine foreman.

Five men are employed driving a new adit to the gold-bearing vein of the Sunshine Gold Mining Company, Box 555, Redding. E. C. Brain is president and general manager. The company is also reconditioning the mill at the mine.

Trinity County

About 940 tons of road slurry are produced per day on east Weaver Creek about half a mile north of the highway. N. M. Ball and Sons, Berkeley, have installed a Cedar Rapids crushing and screening plant which employs eleven men. A. M. Barbre is the superintendent.

A bucket-line dredge is working gold gravels on the Trinity River about 1½ miles below Junction City. This dredge is the property of the Junction City Mining Company, Harvey Sorensen president, 685 Sixth St., San Francisco. Twenty-one men are employed with Derby Wilson as superintendent and S. M. Williams as dredge master.

Tuolumne County

The high and increasing costs of labor and materials and the stationare price of gold have made it unprofitable to continue gold mining at the Eagle Shawmut mine. Consequently, the mine and mill have been closed, and the machinery and supplies are being offered for sale. The owners, Miller and Clemson, 4800 Santa Fe Ave., Los Angeles, have been operating this property since 1938. They were the only important gold quartz operators on the Mother Lode to continue large scale milling during the war period.

Yuba County

A promising gold quartz vein was found one-half mile east of Woodleaf early in 1947. W. P. Bean, Clipper Mills, together with Clyde Stone and Robert Salvi, Challenge, are developing this vein. The hanging wall has been stripped to a depth of 30 feet for a distance of 100 feet along the vein. A tractor and bulldozer were used for this work. A prospect shaft was sunk an additional 30 feet giving a total depth of 60 feet. A small prospecting mill was erected late in 1947, and a few thousand pounds of ore was crushed with good results. The vein is two to three feet wide and shows a considerable amount of free gold.

ZIRCONIUM

Zirconium, in massive form, is a whitish-gray metallic element somewhat resembling antimony. In crystalline form, it belongs to the hexagonal system and is both malleable and ductile. The element produced by some refining processes is separated from its compounds in black, amorphous, powder form. This powder and massive metal prepared from it differ in some physical properties, from massive metal produced by thermal decomposition of zirconium iodide (ZrI_2). The powder form is less stable than the massive form, oxidizing more rapidly and at a lower temperature. It is explosive under certain conditions. Zirconium is attacked by hydrofluoric acid, hot concentrated sulfuric acid, and aqua regia but not by nitric acid and only slightly by concentrated hydrochloric acid. It has an atomic weight of 91.2; atomic number of 40; melting point of 1900°C; sp gr of 6.52; and valence of 4. Zirconium always occurs in combination with hafnium and usually with other metallic impurities. It is very difficult to separate zirconium from hafnium, and the former was obtained in pure form only after years of experimentation by Coster and Hevesy.

Zirconium is found in small quantities in more than a dozen minerals but only two, zircon and beddeleyite, are common enough to be considered ores. Zircon ($ZrSiO_4$) is commonly pale yellow to yellowish brown in color. The rare transparent gem varieties may be colorless, hyacinth red, smoky, or light brown. Color is produced or enhanced by heat treatment of natural zircon. The commonest crystal form is the elongated square prism (usually with terminations). Cleavage is poor, fracture is conchoidal, and luster and refraction approach those of diamond. Zircon is harder than quartz (7.5) and has a higher sp gr (4.68-4.70). Brazilite (ZrO_2), a variety of baddeleyite, is a radial fibrous mineral economically important only in southeastern Brazil. There, it occurs in pebble placers and pegmatites with titanium minerals.

Although zircon is found in many California placers, only one has produced for the market to date. This is located near Lincoln in Placer County. Investigation of "Black sands" in California and other states indicates that zircon can be produced in considerable quantity if the demand and price become great enough. Most present and recent production of zirconium minerals has been from the Caldas district in southeastern Brazil. Other important locations are: Tranvacore in India; Ceylon; Madagascar; Henderson County in North Carolina; Coos Bay in Oregon; and Brevard, St. Johns and Indian River counties in Florida. With the exception of North Carolina and Brazil, the above deposits are all placers. Many important Brazilian deposits occur in hard rock.

Zircon is mined chiefly by sluicing and hydraulicking methods. Certain decomposed pegmatites have been mined similarly. Others, notably in Brazil, have been mined by blasting with dynamite in surface workings. Very little underground mining has been necessary in any of the deposits so far.

Zircon is separated from other constituents of heavy concentrates by electromagnetic and gravitational means. Much of it is recovered as a by-product in separation of monazite sand. Probably in future operations all constituents in "black sand" concentrates will be handled rather than only one or two.

Several thermo-chemical methods are known for obtaining zirconium salts from their ores. All involve initial fusion with one of several alkalies such as calcium oxide (CaO), potassium bifluoride (KHF_2), and potassium bisulfate ($KHSO_4$) followed by digestion in acids and selective precipitation of the desired salts. Zirconium metal is separated from hafnium by fractional crystallization of a hydrochloric acid solution of the metals (by use of a variety of halogen compounds). The end product of this process is a black powder of the metal. Metal in wire or massive form is obtained by heating a wire of the metal to 1400°C in an atmosphere of zirconium iodide vapor. The reaction is maintained by introducing fresh zirconium metal into the furnace. A deposit of ductile metal builds up on the hot wire.

Zirconium and its compounds have attained wide usage in a great variety of industries. The oxide zirconia is an exceedingly important refractory material. Bricks, furnace linings, and furnace cements made with zirconia have a high melting point (over 3000°C), high resistance to slag corrosion, low thermal conductivity, and low coefficient of expansion. Zirconia is also consumed in quantity as a substitute for tin oxide in the enamel industry where it is used as an opacifier. It has extensive use in chemical and electrical porcelains. With fused silica, zirconia is used to increase devitrification and increase tensile strength. Both oxides of zirconium (monoxide and dioxide) are used in glass manufacture to increase durability and chemical resistance. Metallic zirconium is becoming increasingly important as an alloy with other metals, particularly as a hardener in steels. Cooperite, a nickel base alloy containing zirconium, molybdenum, tungsten, silicon, and aluminum, is used for high speed cutting tools. Metallic zirconium is used to increase the ductility of tungsten for filament use. The mineral zircon is a very satisfactory gem material, the blue variety "starlite" having gained wide popularity. Zirconium compounds have a host of minor uses which cannot be discussed here.

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GYPSUM

Gypsum is hydrous calcium sulfate with the formula $CaSO_4.2H_2O$. It belongs to the monoclinic crystal system, the crystals usually being tabular; has cleavage in three directions, one of which is perfect and yields thin folia; and occurs in cleavable masses, foliated granular masses, or more rarely in fibrous masses. Hardness is 1.5-2 (can be scratched with the finger nail); sp gr 2.3; luster vitreous, sometimes silky; color is colorless or white when pure or various shades of yellow, brown, or red if impure. It may be transparent to opaque. An outstanding property is the ability to set when it is partially calcined and mixed with water. Gypsum is distinguished from anhydrite by its softness and lower specific gravity and from limestone by its lighter weight and dissolution in acid without effervescence.

Gypsum occurs in five varieties. Selenite is a colorless transparent form occurring in veins or as scattered plates and crystals. Selenite never forms commercial deposits by itself. Satin spar is a fibrous variety sometimes used for cheap jewelry. Alabaster is massive and fine grained; usually snow white; and easily carved. Rock gypsum, a dull impure alabaster, is the most important variety economically. Gypsite is impure, earthy, or sandy gypsum and is of less economic importance.

A common associate of gypsum is the anhydrous calcium sulfate, anhydrite. Gypsum is also associated with limestone, shale, sandstone, or, less frequently, with rock salt. These deposits are thought to have been precipitated from evaporating saline waters and usually occur in beds which have been folded and exposed by erosion. Although considerable experimental work has been done, it is not certain whether calcium sulfate precipitates as gypsum or anhydrite. As some deposits probably were originally anhydrite and were altered to gypsum by ground water working down from the outcrop, care must be taken to determine how much of a deposit is gypsum and how much is the relatively valueless anhydrite. Gypsum also occurs as gypsite, which is an unconsolidated impure form resulting from the precipitation of gypsiferous waters in the soil, as replacement deposits in limestone, as veins formed by ground water, in the cap rock of salt domes, and as dunes of nearly pure white gypsum sand such as are found in the Tularosa desert of New Mexico. Sometimes gypsum is recovered as a by-product from chemical plants.

In the United States nearly 50% of the production comes from New York, Michigan, and Iowa. The California production in 1945 was 442,133 short tons, amounting to 12% of the total. Gypsum is known or has been produced from forty counties in California, but in 1945, production was entirely from eight properties including a by-product operation in Alameda County. Bedded deposits are worked in Imperial and Riverside Counties. Gypsite is mined in Kern County.

Approximately 25% of the gypsum produced is sold uncalcined. Raw gypsum is used as a retarder in the manufacture of portland cement, in agriculture (land plaster), in crayon manufacture, for pipe covering, in paint filler, and as a diluent in various insecticides and drugs. Calcined gypsum (plaster of paris) is used for stucco, wall plaster, a wide variety of special plasters, and in the manufacture of wall-board, tile, lath, sheathing, and laminated board.

Since crude gypsum is a material of low price, only deposits that can be exploited at low cost are of economic value. For most uses crude gypsum must be more than 90% pure, although for use as a fertilizer this percentage may be very much lower. Cheap methods of mining and quarrying are used, and cheap transportation is essential. In Riverside County the United States Gypsum Company is working steeply inclined beds partly with open cuts and partly by underground methods. Gypsum mined in stopes is removed by Sullivan slushers and loaded directly into cars which are pulled by mules. In flat-lying deposits worked by mining the room-and-pillar method is often used. Gypsite deposits usually can be mined very cheaply with scrapers or power shovels.

Uncalcined gypsum for the cement industry is usually crushed to pass a 2-inch ring. For other uses it is finely ground and sized. The preparation of gypsum for calcined products may be divided into four stages: crushing and grinding, calcining, regrinding, and mixing. The present tendency is to both crush and grind with impact mills of the swing or rigid-hammer type. Standard equipment is used for conveying and elevating crude gypsum until the fine-grinding stage. Because of the tendency of finely ground gypsum to "flood" or "gush", screw or drag-chain conveyors in close-fitting pipes must be used.

In calcining, part of the water of crystallization is driven off. This may be done in beehive or rotary kilns, both of which resemble those used in other industries. Kettles, in which 80% of the calcining is now done, are peculiar to the gypsum industry. A kettle consists of a cylindrical steel shell 8 to 15 feet in diameter and 6 to 14 feet deep with a bottom convex inward. The cover contains a trap for charging raw gypsum and the finished product is withdrawn from near the bottom. Heat is introduced from the fire box by four horizontal flues 8 to 14 inches in diameter. Horizontal rabble arms stir the gypsum and prevent its overheating. The product is discharged into a hot pit built close to the kettle where it is allowed to cool befofe regrinding. Calcining is done in batches and requires from 1 to 3 hours at a temperature which reaches 300° to 330°F. Accurate control is maintained with recording thermometers and by visual observation.

After calcining, gypsum is reground in tube mills or hammer mills. In mixing, some material is usually added to retard the setting. This may be glue, starch, clay, sugar, gums, or slaughter-house tankage. In addition, fibers or fillers required in certain products are added at this time. Mixing is done by stirring with paddles on two sets of parallel horizontal shafts rotating in opposite directions. Recently, methods of grinding and calcining in one operation have been employed.

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California Mineral Production Statistics, 1947

Olaf P. Jenkins, Chief, State Division of Mines, Department of Natural Resources, announces that the total value of mineral production in California for the year 1947, as estimated by the Economic Section, is $744,731,000. The output is detailed in the tabulation below. Since more than sixty mineral substances are produced, only the most important items are available at this early date. The production report forms are now being mailed to the producers of all minerals, and a complete report will be published when the returns have been received and compiled.

The estimated total of $744,731,000 is an increase of approximately $185,282,000 over the 1946 total of $559,449,496 and is the largest mineral output on record. This was the result of an unsurpassed output of petroleum with the highest average price per barrel ever recorded. Increases were noted also in the output and value of gold, silver, cement, salines, and miscellaneous stone.

The petroleum output for 1947 increased about 15,352,000 barrels or about 5 percent in amount, but its value increased $177,700,000, approximately 46 percent over the 1946 figure. This large increase in value was the result of the following price increases during the year: about 20 cents per barrel in March, 20 cents per barrel in July, 10 cents per barrel in October, and 50 cents per barrel in December.

The value of natural gas produced during the year was approximately the same as for 1946, with a small increase in quantity. The gold output in 1947 will show some increase over that of 1946. Silver, lead, and tungsten showed an increase in total value with all other metals declining in quantity and value. The value of cement and miscellaneous stone for the year reached an all time high owing to the increase in private building and public construction. Many of the industrial non-metallic minerals showed increased production to meet manufacturing demands. Most salines showed a record year with many plants increasing their capacity, and one new plant coming into production during the year.

Estimated values and quantities for 1947 are as follows:

Gold	$ 14,376,000	(410,740 fine ounces)
Silver	1,437,000	(1,644,000 fine ounces)
Copper	995,000	(4,760,000 pounds
Lead	2,975,000	(20,380,000 pounds)
Zinc	1,240,000	(10,600,000 pounds)
Quicksilver	1,275,000	(15,000 flasks)
Other metals	3,750,000	including chromite, iron ore, molybdenum ore, platinum group metals, and tungsten ore.
Petroleum	564,531,000	(332,468,000 barrels)
Natural Gas	45,143,000	(551,786,000 M cu. ft.)
Cement	37,194,000	(22,400,000 barrels)
Miscellaneous stone	28,500,000	
Brick and hollow tile	5,600,000	
Other industrial non-metallic minerals	15,175,000	including clay, granite, gypsum, mineral water, pumice and pumicite, silica, talc, etc.
Salines	22,500,000	including borates, iodine, potash, magnesium salts, salt, soda, etc.
Total value	$744,731,000	

COMMERCIAL MINERALS OF CALIFORNIA

- ▲ DEPOSITS PRODUCING COMMERCIAL AMOUNTS 1935-38. (NAMES & ADDRESSES NOTED IN DIRECTORY OF PRODUCERS OTHER THAN NATURAL GAS & PETROLEUM.)
- △ DEPOSITS OF SMALL PRODUCTION. OR AS BY-PRODUCT IN MINING FOR OTHER MINERALS.
- X DEPOSITS OF KNOWN COMMERCIAL VALUE. NOW IDLE.
- O DEPOSITS OF LITTLE OR UNKNOWN COMMERCIAL VALUE (NOTED IN REPORTS OF THE STATE MINERALOGIST.)
- ⧗ PLANTS NOW IDLE OR UNDER CONSTRUCTION

	ALAMEDA	ALPINE	AMADOR	BUTTE	CALAVERAS	COLUSA	CONTRA COSTA	DEL NORTE	EL DORADO	FRESNO	GLENN	HUMBOLDT	IMPERIAL	INYO	KERN	KINGS	LAKE	LASSEN	LOS ANGELES	MADERA	MARIN	MARIPOSA	MENDOCINO	MERCED	MODOC	MONO	MONTEREY	NAPA	NEVADA	ORANGE	PLACER	PLUMAS	RIVERSIDE	SACRAMENTO	SAN BENITO	SAN BERNARDINO	SAN DIEGO	SAN FRANCISCO	SAN JOAQUIN	SAN LUIS OBISPO	SAN MATEO	SANTA BARBARA	SANTA CLARA	SANTA CRUZ	SHASTA	SIERRA	SISKIYOU	SOLANO	SONOMA	STANISLAUS	SUTTER	TEHAMA	TRINITY	TULARE	TUOLUMNE	VENTURA	YOLO	YUBA
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MINERAL INFORMATION SERVICE

Vol. 1 March 1, 1948 No. 3

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications.

This pamphlet takes the place of previous news releases, Information Circulars, etc., and is distributed without cost upon request.

It has been called to our attention by higher authority that there is no statutory authority for this state agency to publish want ads or for sale notices (formerly released as "Commercial Mineral Notes"). To comply with these instructions, we are discontinuing this service.

Notes on Current Mining Activity in California

Amador County

The Edwin underground clay mine at Jones Butte, west of Ione, has been operated for many years by Gladding McBean and Company to supply a highly refractory clay (cone 34) for use in fire brick. This mine will be closed and future operations on the property will be by open pit mining. Stripping of overburden and loading of the clay by Caterpillar tractors and bulldozers will save much manual labor.

Inyo County

Lead ore to the amount of 80 tons per day is being milled from properties near Tecopa by Shoshone Mines, Anaconda Copper Mining Company. Forty-eight men are employed under supervision of Burhl Dykehouse of Tecopa.

Milling of lead ore from the New Southerland Mining Company's operations 11 miles northwest of Ashford Mill in southern Death Valley is on a two-shift-per-day basis. The mill is designed to handle 100 tons of ore per day. Custom ore will be handled as capacity permits. Eighteen men are employed. John E. Gallois, 985 Mills Building, San Francisco, is President and J. L. Desmond of Shoshone is Superintendent.

Volcanic ash is being shipped from the Charles Brown deposit, 1/4 mile south of Shoshone, by Western Talc Company, F. H. Savell, President, 1901 E. Slauson Avenue, Los Angeles.

Kern County

Equipment is being moved from the Yellow Astor tailings plant for use in the new mill at the Baltic mine, 1-1/2 miles southeast of Randsburg. Ten men under the direction of Mr. I. D. Budd of Randsburg are employed at this gold property.

Gold placer ground north of Randsburg, formerly worked by the Rand Gold Dredging Association, is now being prepared for dredging by Foley Brothers, Randsburg. A dragline dredge capable of handling 250 yards per day is expected to be in operation by March 1.

A perlite deposit located eight miles north of Cantil in the El Paso mountains is being drilled by Production Research, Incorporated, of Pasadena. The deposit is owned by Della G. Gerbracht of Randsburg.

Placer County

The Mary Len mine near Penryn is one of the few small gold quartz properties which have managed to remain active in spite of a scarcity of mine labor and high operating costs. The shaft is 240 feet deep and the vein, which is 8 to 16 inches wide, has been opened and mined on two levels. A new milling plant was erected early in 1947 which has a capacity of 25 tons a day. It is a ball mill with flotation cells. The mine is owned by Ted Novas et al. A partnership composed of Al Broyer, Vic De Campos, M. R. Fleming, and Thomas Seitzinger have been mining and milling the ore.

Production of iron ore, on a small scale, from the Hotaling Iron mine near Clipper Gap has been carried on during 1947. This mine was operated early in the year by Peterson and Wimmler and after July by Orrin P. Peterson of Auburn. Lump ore 6 to 12 inches in size is shipped to reverberatory-type furnaces and ore from 1 to 6 inches to an electric furnace. Mining has been done in an open pit with Caterpillar tractor and bulldozer. This is a contract operation.

Sacramento County

A dragline dredge has recently been installed on Ryan and Stanton land near Bridge House by C. R. Garibaldi of Sutter Creek. A 2-1/2 cubic yard dragline with 1-3/4 yard heavy duty bucket will supply gravel to a Bodinson floating washing plant having a capacity of 100 cubic yards an hour. Part of this land was dredged before the war by Humphreys Gold Corporation. Eight men will be employed.

Sacramento and Yuba Counties are, at present, among the few important gold producing counties in the state, the former because of large bucket dredges being operated by Natomas Company and the latter owing to dredging carried on by Yuba Consolidated Gold Fields. Nevada County, with production from the Empire Star and Idaho-Maryland properties at Grass Valley and the Ancho-Erie near Washington, is the leading vein gold-quartz producer. Gold dredging in the Sacramento Valley and adjacent foothill sections, where about 15 bucket dredges depend upon electric power, has been curtailed during February because of the power shortage resulting from lack of rain.

San Bernardino County

Silver ore from the Silver Hills Mining Corporation deposit, located five miles east of Renoville, is being shipped to Salt Lake City. The ore was produced during recent development work on the property. Construction of 1/2 mile of road to connect with a proposed development tunnel and loading bin is under way. W. R. Long is President and W. J. McCray is Vice President and General Manager of the corporation with Offices at 11320 Atlantic Avenue, Lynwood, California.

Talc shipments from the Monarch mine at Ibex Springs are being made regularly by the Sierra Talc Company. Don Kempfer of Shoshone is in charge of the company's operations in San Bernardino County.

Siskiyou County

Dredging operations on Horse Creek were stopped January 10 and the Scandia No. 1 dredge owned by Larsen Brothers and Harms Brothers of Sacramento is being dismantled for shipment to British Columbia. R. I. Barritt was dredgemaster and 14 men were employed.

The new mill at the Quartz Hill mine in the Scott Valley area was put into operation January 12. The ore is crushed to 16 mesh and the free gold recovered on amalgamation plates. Concentrates are saved on expanded metal lath. A total of 12 men are employed in the open pit and mill. Harry Thompson is in charge of operations.

Eighteen men are employed by the French Gulch Dredging Company at their operation on Indian Creek. The gravel is about 20 feet deep and lies on a soft porphyry bedrock. Ed Shuford is dredgemaster.

Hydraulic mining was resumed at the old Fort Goff mine on the Klamath River near Seiad on January 15. The property is operated by J. W. Welch and three men are employed.

The bucket-line dredge of the Yuba Consolidated Gold Fields on the Scott River near Callahan is digging about 50 feet below water line. Seventeen men are employed and W. B. Lewis is dredgemaster.

An old river channel located about 40 feet above the present Klamath River is being mined by hydraulicking at the Donnelly Placer about six miles east of Happy Camp. The property is being worked by C. E. Reagan of Happy Camp and his two sons.

A bucket-line dredge is being assembled at the Reeve Ranch on the west bank of the Klamath River about two miles above Happy Camp. It will be operated by the Reeve Ranch Dredging Company. Thomas F. Nicholls of Happy Camp, President of the Company, has a contract to purchase the property.

LIST OF NEW PUBLICATIONS

Copies of the following publications, which have recently been acquired by the Library of the Division of Mines, are now available for reference but are not on sale by the Division.

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COPPER

Copper is one of the oldest and best known metals. Together with iron, its appearance and properties are known to everyone. Being the only red metal known, it has been used throughout history for decorative purposes. It is the best of the base metals as a conductor of electricity. Copper and many of its alloys harden markedly when hammered, drawn, or forged in a cold condition. Heating restores the softness to metal so hardened. Most of the water-soluble copper compounds are very poisonous. Copper compounds are usually bright colored in shades of blue, red or green.

More than 20 copper minerals are classed as ores in various copper districts of the world. The commonest primary minerals are: chalcopyrite ($CuFeS_2$), bornite (Cu_5FeS_4), tetrahedrite ($3Cu_2S \cdot Sb_2S_3$), enargite ($3Cu_2S \cdot As_2S_5$), and tennantite ($3Cu_2S \cdot As_2S_3$). The most important secondary minerals are: native copper (Cu), chalcocite (Cu_2S), Cuprite (Cu_2O), covellite (CuS), azurite ($2CuCO_3 \cdot Cu(OH)_2$), and malachite ($CuCO_3 \cdot Cu(OH)_2$). Atacamite ($CuCl_2 \cdot 3Cu(OH)_2$) and brochantite ($CuSO_4 \cdot 3Cu(OH)_2$) are important secondary ores of the oxidized zone in the desert mines of Chile. A majority of the large California copper deposits are veins or lodes of simple sulfide type, but oxidized deposits are important in Inyo County and occasionally in other localities. Zinc, lead, and silver are often associated with copper especially in Inyo County.

More than 40 of the 58 California counties have reported copper production from time to time, and more than 25 counties produced the metal during the last war. Production in California has dropped off sharply since then, and only six mines in five counties marketed copper in 1946. The major copper districts during the last decade were: Happy Camp, Siskiyou County; Flat Creek, Shasta County; Copperopolis and Campo Seco, Calaveras County; Ione, Amador County; Yankee Hill, Butte County; Hunter Valley, Mariposa County; Darwin and Modoc, Inyo County; and the Genesee Valley (Engels), Plumas County. Copper production reached an all time high in 1909 when 65,723,736 pounds were marketed. Although California has added a substantial quantity of copper to the national output, the major domestic sources have been Arizona, Utah, Montana, Nevada, New Mexico and Michigan. Principal foreign sources are: Chile, Rhodesia, Belgian Congo, Canada, Russia and Japan.

Copper mining in California is almost entirely of underground type. There are no large scale open pit workings such as those at Bingham Canyon, Utah, and Ajo, Arizona. Most of the known underground methods are employed in various mines. Deposits in the Sierra Nevada Range tend to be rather narrow and steeply dipping. Those in Shasta County may be veins or vein systems of variable dip or else massive replacement bodies. Inyo County ore bodies are mainly oxidized contact replacements of irregular shape.

In general, extraction of copper from sulfide ores involves crushing, concentration, smelting and refining. Oxidized ores are often treated by leaching, recovery being accomplished by chemical and electrolytic separation of the metals which have been dissolved in the leaching solutions. Flotation is based upon the fact that certain minerals, when pulverized and agitated in a suitable aqueous mixture of "collecting" and "frothing" agents, attach themselves to the walls of the bubbles formed during the agitation and are floated free of impurities. Different combinations of flotation agents will float different minerals or groups of minerals; hence, separation as well as concentration can be accomplished by flotation. Leaching may take place either at the mine (on ore in place or broken and left in the mine) or on previously-mined ore stockpiled for that purpose. Direct smelting of copper ore is seldom done in modern practice. The most common procedure is first to roast the concentrate (to drive off excess sulfur and produce a partly oxidized calcine), then to smelt the hot calcine to a molten sulfide matte (removing part of the non metallic impurities as slag), then to convert the matte to blister copper, and finally to separate the precious metals and remaining worthless impurities from the blister copper by further furnace refining and electrolysis of the cast, furnace-refined product. The conversion of matte to blister copper is dependent upon the fact that in the converter, iron sulfides oxidize before copper sulfides. As a result, iron sulfides can be converted to oxide form and combined with the flux to form a slag before any great amount of copper is lost. Electrolytic refining of copper is essentially the ionic transfer of copper from the impure form at the anode to a pure form at the cathode via a suitable electrolyte (usually an acid solution of copper sulfate). The precious metals drop to the bottom of the tank and are recovered by smelting the sludge.

Copper is used for an infinite number of purposes. The largest single use is as an electrical conductor (principally as wire). Preparation of standard alloys such as brass and bronze for fabrication into countless articles also takes a large percentage of the annual output. During the last war a large number of new alloys of copper were developed such as tungsten-copper for contacts and cadmium-beryllium-copper and cadmium-silicon-copper for resistance welding electrodes. High tensile, fatigue resistant, corrosion resistant bronzes containing manganese, silicon, aluminum, and other metals were developed as substitutes for tin-hardened bronzes during the wartime tin shortage. Other common uses for copper or its compounds are: coinage, insecticides, chemical indicators, and semi-precious gems.

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IRON

Iron, the fourth most abundant element in the earth's crust, is a major constituent of many minerals, but of these, only hematite (Fe_2O_3), magnetite (Fe_3O_4), limonite ($2Fe_2O_3.3H_2O$), and siderite ($FeCO_3$) occur in important, economically exploitable concentrations. Hematite, the principal ore mineral, is black to dark red, has a hardness of 6, a metallic to dull luster, a specific gravity of about 5.2, and assumes a variety of forms (i.e., earthy, compact, columnar, botryoidal, micaceous, fibrous and several rhombohedral crystal forms). It is distinguished from magnetite and limonite by its red streak.

Magnetite, the chief ore of iron in California, is a black mineral of metallic luster with a black streak, a hardness of 6, and sp. gr. of about 5.1. It is distinguished from other black minerals by strong attraction to a magnet.

Limonite is second to hematite in U. S. production and, except for a characteristic, yellowish brown streak, often closely resembles the colloform, earthy or massive hematite. It has a hardness of 5.5, a specific gravity of about 3.8 and a submetallic to dull luster.

Siderite, an unimportant ore in the United States, is a light brown to gray, vitreous or adamantine mineral with a characteristic rhombohedral cleavage. It is distinguished from calcite by the comparatively high sp. gr. of about 3.8. It occurs in coarse or fine granular masses and in botryoidal, globular, fibrous and earthy forms as well as in well-formed rhombohedral crystals.

Detailed discussions of the treatment of iron ores are contained in several of the attached bibliographic references. Briefly, the production of pig iron involves reduction of the ore to metal and the elimination of impurities. Coke is used for the following purposes: to supply heat to the reducing furnace; to furnish the carbon which unites with the oxygen of the ore minerals to produce metallic iron; and to furnish the carbon which remains in the iron or iron alloy (steel) to give it certain desired properties. Silica and aluminum, the most abundant impurities excepting oxygen, are removed as slag by combination with a suitable flux. Oxygen, sulfur, and phosphorus are the most deleterious impurities remaining in pig iron. Sulfur and phosphorus are kept below certain maximum values in mining the ore.

Production of steel from pig iron involves further elimination of impurities and addition of certain elements to produce various desired properties in the finished product. Ferrosilicon and ferromanganese are commonly used to reduce oxygen and sulfur to negligible proportions. Furnace linings of magnesium-rich bricks remove much of the phosphorus. Carbon is reduced to the desired content by blowing air through the molten metal.

Sedimentary iron ores, characterized by the Lake Superior region deposits, are by far the most important single geologic class. Magmatic segregations, typified by the famous magnetite deposits of northern Sweden, occur as relatively small bodies in New York and Missouri. California iron deposits are chiefly of a third class, the so-called "contact-metamorphic" ores. These bodies have been formed by volatile materials that have escaped from an iron-rich granitic magma, and have deposited magnetite in limy sedimentary rocks.

The iron reserves of California, although much smaller than those of the major iron-producing areas of the world, have, since 1942, contributed most of the [illegible].

consumed by the Fontana steel plant of Kaiser Company, Inc. Formerly production had been limited to small amounts consumed by an early pig iron industry and, in later years, to somewhat larger tonnages used for ship ballast and in the manufacture of high-iron cements. The future operations of the Fontana plant will depend almost entirely on a California source, that at Eagle Mountain near Desert Center in Riverside County. Previous production has come from the Vulcan Mine southeast of Kelso in San Bernardino County. Among the occurrences of potential importance to the iron industry are the Iron Mountain (Lava Bed district), Iron Mountain (Silver Lake district), Iron King, Old Dad, Cave Canyon, Iron Hat, Ship Mountains, and Beck deposits, all in San Bernardino County, the Minarets deposits in Madera County, and the Hirz Mountain, Shasta, and California deposits in Shasta County. These are principally magnetitic ores with or without associated hematite and limonite. All, with the exception of the Ship Mountains and Minarets deposits, are of the contact-metamorphic class. The latter two consist, respectively, of hematite lenses in brecciated igneous and metamorphic rocks and magnetite lenses in metamorphosed volcanic rocks.

A daily production of 3500 tons of ore will be removed in an open cut operation at Eagle Mountain. This will be handled by the present Fontana facilities which include a blast furnace with daily capacity of 1200 tons of hot metal and six open hearth furnaces with a total monthly capacity of 60,000 tons of steel ingots. Other materials consumed in the blast furnace operation include limestone from the nearby Colton quarry, manganese imported from Mexico and coal from Sunnyside, Utah, and McAllister, Oklahoma. The following materials are used in the open hearth furnaces: raw limestone from Oro Grande, San Bernardino County; burned limestone and raw dolomite from Sloan, Nevada, burned dolomite from Salinas, Monterey County; fluorspar, chiefly from Fallon, Nevada; and runner clay from Alberhill, Riverside County.

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New Activities at the Brown Bear Mine, Trinity County

A caved adit on the Coon Dog claim of the Brown Bear mine in Trinity County was reopened recently after lying idle for many years, and a six foot vein of gold ore was found right where some of the old timers said it would be. The vein had been developed by a drift for about 500 feet, but most of the old timbers had decayed and fallen. Portions of the crosscut adit had also caved, so all timbers had to be replaced and some spiling was necessary. The vein is on a contact of porphyry with slate and includes quartz stringers and crushed fragments of both slate and porphyry along with much pyrite. The gold is intimately associated with the sulfides and very little shows when the ore is panned. Consequently, all samples are sent to San Francisco for assaying. Ore showing galena and calcite with the pyrite usually carries good gold values, and those minerals are considered to be good indicators.

The old milling plant near the portal of the Watt adit has been put into shape to crush and concentrate the ore. An amalgamation plate in the circuit catches very little gold although ore running high in gold often passes over it. Concentrates from a jig, Wilfley table, and six flotation cells are sent to the Empire cyanide plant at Grass Valley by truck. The Brown Bear mine is owned by E. E. Erich of French Gulch and it is operated under lease with option by Western Gold Mines, Incorporated, Silas P. Silverman, President. Dave Rice is General Superintendent; Austin Merrill, Mill Superintendent; and Jesse Cuddeback, Mine Foreman. Eighteen men are employed.

Olaf P. Jenkins, Chief
State Division of Mines
Ferry Building,
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MINERAL INFORMATION SERVICE

Vol. 1 April 1, 1948 No. 4

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications.

This pamphlet takes the place of previous news releases, Information Circulars, etc., and is distributed without cost upon request.

REVISION OF POLICY ON RELEASING MINERAL PRODUCTION BY COUNTIES

The following question has recently been submitted to the Attorney General:

"Are the Division of Mines and the State Mineralogist required to disclose to (1) legislators or (2) members of the general public, information concerning mineral production of specific mines gathered by the Division pursuant to sections 2207 and 2208, Public Resources Code?"

The conclusions reached by the Attorney General (copy of the Opinion No. 47-76, February 6, 1948, will be supplied by the Division of Mines on request) are summarized as follows:

"There is no statutory right to inspect the individual mine reports collected under sections 2207 and 2208, Public Resources Code, since such reports are not public writings or records. The reports may be inspected only by those having some substantial right dependent upon inspection. Therefore, the reports need not be disclosed to the public generally, but should be disclosed to the Legislature and the authorized committees thereof upon request."

In the past the California State Division of Mines and its predecessor the State Mining Bureau have released mineral production figures in the following manner: (1) by mineral commodity; (2) by county, with the exception that where there are only one or two producers of a particular mineral substance in a county, the figures were so combined as to conceal the production of that mineral; (3) by totals for the State.

In view of a recent demand for complete data on production of each mineral substance by county regardless of the number of operators in the county, the State Mining Board (which establishes the policies of the Division of Mines) has revised the form of the questionnaire previously sent the operators. On forms used in the past, the following statement was made:

"DATA OF INDIVIDUAL MINES OR PROPERTIES WILL NOT BE REVEALED IN THE REPORT, the figures you send will be considered as strictly confidential, will not be shown to anyone, and will be used in the totals only; THEREFORE NO PRIVATE BUSINESS IS MADE PUBLIC."

On the new form (effective for the 1947 statistics) as determined by the Mining Board the following statement is substituted:

"In order that the State Division of Mines may make timely exhibit of statistics on production of metals and non-metals by Counties, and as a total for the State, the subjoined questionnaire is sent for your convenience in supplying information required of the owner, lessor, lessee, agent manager, or other person in charge of any mine of whatever kind or character within the State, under Chapter 93, Statutes of 1939, State of California Public Resources Code.

"The questionnaire should be completed and returned duly executed to this office by the 31st day of March next succeeding the period reported on in the form."

Beginning with the 1947 statistics, information on production of minerals will be published by totals for the state and totals by counties, regardless of the number of operators in each county, but names of producers will not be published at that time.

As there has also been a demand for information on mineral production by counties for the year 1946, a letter has been sent out to determine whether any firm, which was the sole operator or one of only two operators within a given county, would find release of its 1946 production on any specific mineral to be of adverse effect provided the name of such a firm or firms was not released with the production figures.

JAMES M. LITTLE PASSES

James M. Little, Mining Engineer and Geologist of the State Division of Mines, died Sunday, March 7th, after a long illness. Mr. Little had been in charge of the information desk at the Division offices in the Ferry Building, San Francisco. He was a graduate of the School of Mines of Columbia University and had carried on professional mining work in the southwestern United States and Chile. Published works by Mr. Little included monographs on the geology and ore deposits of Chile, the tungsten deposits of California, and the mechanics of soil erosion. The loss of Mr. Little will be deeply felt by the mining fraternity, and he will be remembered for his patient and careful attention in securing authentic information for the public.

NOTES ON CURRENT MINING ACTIVITY

Recent Developments in Shaft Sinking Methods

The Santa Cruz Portland Cement Company limestone quarry at Davenport, Santa Cruz County, is being enlarged. Shafts are being sunk by core drilling methods, the drill hole being three feet in diameter. Solid cores of rock up to five feet in length and weighing many tons can be extracted by this method. Standard oil well derrick and surface equipment is used to drive a large cylindrical cutting bit and core barrel. Fine, hard, steel shot is fed to the lower edge of the steel bit which is rapidly rotated. At the above location, the drilled shaft stands open with smooth, clean walls even though the rock is so broken that cave-ins would have resulted if standard shaft sinking methods (using close-timbering, lagging, etc.) had been used. This type of shaft sinking promises to result in development of rapid and cheap methods for exploration, development, ventilation, and escapeway engineering. Present progress on the Davenport job is going forward at the rate of more than five feet per shift. A rate of over ten feet per shift is thought to be possible with improved equipment.

Famous Gem Mines Reopened

The gem mines of the Pala district in San Diego County have been reopened. The Frederick M. Sickler holdings on Heriart Mountain have been sold to Mr. George Ashley, purchase taking place in mid-July, 1947. Ashley has since disposed of some of the claims to others, but the present owners have all been doing rehabilitation work at the mines. The Katerine claim, retained by Ashley, has been the center of greatest activity. Mine workings have been reopened, a water-pipe line has been laid, and new compressed air equipment installed. A new adit is being driven on the Katerine pegmatite. During rehabilitation work some gem spodumene or kunzite was recovered. Plans are being made to reopen the Vanderburg claim, another old time producer.

Argonaut Mine Abandoned

The Argonaut gold mine at Jackson, idle since March 1942, has been formally abandoned. The Argonaut Mining Co., Ltd., of San Francisco was dissolved as of Feb. 16, 1948, thus ending one of the most important and successful deep mining operations on the Mother Lode. The property covers 4800 ft. along the lode. The collar of the Argonaut shaft is about 1500 ft. above sea level, and the deepest level, the 6300, is about 5570 ft. vertically lower. Over 8 miles of drifts, crosscuts, and tunnels were opened; over 4 miles of raises were driven; and 50 miles of stope floors excavated. The total production of the Argonaut to Dec. 31, 1942, was 2,750,600 dry tons of ore, from which $25,179,160.43 were recovered.

RECENT DEVELOPMENTS IN THE TALC INDUSTRY

California talc mining reached an all time high during 1947. This industry, which underwent a rapid wartime expansion, has continued its upward trend, and the 1947 production was estimated to be approximately $1,000,000. This is nearly three times the 1939 figure. The principal deposits (in Inyo and San Bernardino Counties) are currently being studied by L. A. Wright, Associate Geologist of the State Division of Mines, in a program which is receiving close cooperation of the operators. The development of new applications for California talcs together with the post war building boom account for much of the current upswing in talc mining. Somewhat recent innovations in the industry include the introduction of tremolitic talc as one of the principal raw materials used in the manufacture of high-grade tiles, and the use of steatite-type talcs in the manufacture of insulators for high-frequency electrical equipment. The paint, rubber, textile, and ceramic industries are also consumers of California talc.

PERLITE

Perlite is a variety of obsidian. Obsidian and pumice are acidic volcanic glasses produced from a granite magma during volcanic eruption. These types of rock are complex amorphous silicates of aluminum, sodium, and potassium, with minor amounts of other constituents. They contain 65% to 75% silica; 9% to 20% alumina; less than 8% sodium and potassium oxides; less than 3% calcium and magnesium oxides; less than 3% iron oxide; and between 0.1% and 6% combined water (ignition loss). Some varieties of obsidian, notably the perlitic variety (perlite), will expand up to twenty times volumetrically upon exposure to heat within a range of 1400°F to 2500°F. This property of expansion into a glass foam or synthetic pumice, many properties of which can be made to vary at the will of the processor, makes expanded perlite a material of great potential industrial value.

Very large deposits of the obsidian family of rocks are found in all of the western states. In California, deposits of perlite and other types of obsidian are known in Siskiyou, Modoc, and Shasta counties in the northern part of the state; Lake, Napa, and Sonoma counties in the central part; and Mono, Inyo, Kern, San Bernardino, Riverside, Imperial, and San Diego counties in the southern part. Many of these known deposits are close to existing railway lines and paved highways, and within a few hundred miles of large Pacific Coast consuming centers.

The industrial uses of expanded perlite may be summarized as follows: (a) As inert, lightweight aggregates in concrete and plaster where its use results in excellent insulation properties, high strength to weight ratio, and other advantageous properties in the finished concrete or plaster. (b) As an insulating medium. With or without a binder, certain types of expanded perlite have the advantage of very low thermal conductivity ("K" factor), little tendency to absorb moisture or odors, inertness to chemical or insect attack, very light weight, and no tendency to pack or disintegrate after placement. (c) As an abrasive, especially as an ingredient in scouring soaps and cleansers, pulverized lightweight expanded perlite has many advantages over natural pumice. (d) Miscellaneous industrial uses include: filler in rubber and paints, filter aid, absorbent material, insecticide carrier, soil modifier, chicken litter, and catalyst carrier in chemical processes. Perlite rock is in use as raw material for the manufacture of rock wool. In this use, its properties as a slag-forming rock are utilized.

Each of the foregoing industrial uses requires a material of definite specifications; the physical properties differ greatly from the properties requisite to other uses. These controlled differences in physical properties between various types of expanded perlite are a function of the chemical composition of the raw material (variation in analysis within the range of composition stated for the acid volcanic glasses), and the exact method of processing the crude rock into expanded perlite. When an obsidian subject to expansion is heated rapidly to the point where the rock particles are in a pasty, viscous, but not fluid condition, the evenly distributed gas-forming constituents of the rock (principally water) expand into bubbles, causing the cellular texture of expanded perlite. The chemical composition of the rock, rate of heating, maximum temperature in the heating zone, and rate of cooling, are all important variables affecting the physical properties of the processed perlite. A furnace suitable for commercial expansion of perlite is provided with means for the exact control of all of these variables except the composition of the rock itself. As perlite is not a mineral, variations in composition are found between different deposits and within the same deposit. Each type of obsidian subject to expansion tends to yield a definite type of expanded material when processed in the simplest type of furnace. In order to modify, to some extent, the physical properties of such a material, a wide range of exact control of rate of heating, temperature in various heat zones of the furnace, rate of passage of a rock particle through the furnace, and rate of cooling of the product must be provided for in the furnace design. Many types of retorts or furnaces have been designed to expand perlite. Relatively few of these have been commercially successful, and most failures may be traced to failure to recognize and provide for the factors outlined in the foregoing paragraph. Among the types of perlite-expanding furnaces are horizontal, internally fired, stationary and rotary cylindrical machines somewhat like a modified cement kiln; various types of inclined rotary tube externally fired retorts; many types of vertical furnaces (basically a flue fired at the bottom and fed from the top); and various electrically heated mechanisms, including high-frequency induction heating. To date, the most successful commercial furnaces are internally fired cylindrical types. Some of these are inclined and others are horizontal; some are stationary and some are revolving.

At present there is no definite price structure or standards for expanded perlite, as this industry has not evolved beyond the research and pilot-plant stage. Indications are that expanded perlite in the density range of 8 to 20 pounds per cubic foot, suitable for plaster and concrete aggregate, will sell for between 6¢ and 12¢ per cubic foot, in bulk, at plant, depending on producer's profit and local conditions. This price range might be expected to stabilize within the next two years in some localities. Crude perlite rock is, at present, sold at from $5 to $7 per ton, f.o.b. car, producers shipping point.

As a plaster aggregate, expanded perlite has the following advantages over sand: (1) From 2000 to 4000 pounds per 100 square yards of standard three coat plaster are saved; (2) Approximately 12 man-hours per hundred square yards in labor are saved owing to the light weight and ease of application; (3) The "k" factor of perlite plaster varies between 0.4 and 0.8; that of sand plaster between 3.00 and 3.50; that is, the heat insulating value of perlite plaster is about five to six times that of sand plaster; (4) Perlite plaster is much more resistant to cracking under blows, shock, or strain than sand plaster; (5) The acoustic properties of perlite plaster are superior to sand plaster.

As an aggregate in concrete, expanded perlite has many definite advantages where a compressive strength in the finished concrete above about 2000 p.s.i. is not imperative. The following table illustrates the properties of a typical perlite concrete of varying cement-aggregate ratio:

Cement-agg. ratio	Density, lbs. per cu. ft. as poured	Density, lbs. per cu. ft. 28 day	Compressive strength, 28 day	"k" factor	Water absorb. lbs. per cu. ft.
1:2	74	66	2564	1.87	14.2
1:3	63	54	1574	1.65	17.1
1:4	58	47	1149	1.40	14.2
1:5	55	41	654	1.23	15.4
1:6	51	37	477	1.18	15.6
1:8	49	32	366	1.02	16.7

When used as bulk loose fill insulation, expanded perlite may be expected to yield a "k" factor between 0.2 for 3 pound per cubic foot material, to 0.5 for 12 pound material.

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ROOFING GRANULES

The term "roofing granules" includes a considerable variety of granular materials used for covering asphalt-impregnated felt roofing. The grains are put onto the felt base either at the time of manufacture of the felt roll or are added as a final covering at the time the roof is laid down. Roofing granules fall under three general classifications: natural materials, artificially colored natural materials, and manufactured materials such as brick, ceramics and slags. Separate specifications have been set up for granules to be used on ready-prepared roofing and for granules for use on built-up roofs.

The original purpose of a covering material was to prevent the layers of the roll of ready-prepared roofing from sticking together. Talc and mica backing is still used for this purpose in considerable quantities. Later, the advantage of a thicker coating for fire protection was discovered. This led to standardization of grain size and marketing of certain sizes for certain purposes. Increased fire protection of the coated roofing and a profitable outlet for the waste fines of the roofing slate industry gave the roofing granule business its present impetus.

The demand for and development of color in roofing has advanced the industry beyond the purely utilitarian purpose it once served and has placed the greater emphasis on artificially colored materials. The granules industry is a very competitive one and the use of coloring agents has made possible the utilization of low-cost materials formerly unsuited to this purpose. The rock, sand, and gravel business produces much of the base material for artificially colored granules. To serve as roofing granules, a rock aggregate must have the following general characteristics: ability to retain its color (natural or artificial) against the black, asphaltic background; good adhesive qualities under all weather conditions; a shape suitable to provide good coverage per unit particle; non-absorbent qualities so that disintegration by freezing and thawing of included water will not take place; resistance to abrasion to prevent breakdown during handling (must be fairly hard); and uniformity of grading to prevent segregation of sizes during shipping and handling.

The process of coloring is, in general, one of mixing the sized granules with a sodium silicate slurry containing the desired color pigment. The granules are then heated to sinter the silicate into a transluscent or opaque glaze. A transparent glaze is not desirable. The silicate type of coating is stable and weather resistant.

The adhesive quality of granules is largely a function of the roughness of the particle surface. Rounded grains such as beach sand and smooth, flat cleavage pieces are undesirable. Crushed material is almost always used.

Good coverage of the asphalt-felt base is necessary in order to subdue the black color of the asphalt and to protect it from the actinic rays of the sun. A rough but flattened type of particle is ideal, but few rocks exhibit both characteristics.

The only natural material used in any quantity is slate. Ninety percent of the slate granules are produced in the eastern states such as Maine, Vermont and Pennsylvania. Only 10 percent are produced in California. About 60 percent of all slate is used in its natural color. California slate is blue-black and is used without artificial coloration. One property northwest of Placerville supplies all of this material. Slate represents roughly one third of all materials used for roofing granules in the United States. In California the figure is probably less than one fourth. Other materials that have been used in their natural colors are greenstones (a field term for any fine grained, altered, igneous rock having abundant green minerals) and jaspers (red). Ilmenite and magnetite have been used for roofing granules but probably cannot now compete because of their color. Natural talc and mica are still used where a thick protective coating is deemed unnecessary.

Artificially colored materials are used in far larger quantity than naturally colored ones. Some slate is colored artificially, but most of the colored granules are made from crushed granite. Granitic particles have most of the desired characteristics, and fines from the aggregate industry can be obtained at low cost. Crushed brick is a synthetic material used to some extent for red granules. Both natural and synthetic granules for use in ready-prepared roofing have size limits ranging from minus 8 mesh to plus 35 mesh; 1 to 3 percent of minus 35 mesh material is usually permissible.

Built-up roofs (roofs in which the felt and the covering material are applied separately) require coarser granules than the aforementioned ready-prepared roofing. The size range is usually from minus 3/8 inch to plus 16 mesh with the largest percentage between minus 3 and plus 6 mesh. The coarse granules for built-up roofs are usually crushed brick or artificially colored crushed granitic rock. Dolomite is a newcomer to the roofing-granule field. It is a dense, white rock with excellent heat reflecting qualities. The principal disadvantage of dolomite is that its flat cleavages do not make for good adhesion to the asphalt surface. Dolomite for this purpose must be white, free from minerals which would weather to some other color, and have a low content of water-soluble material.

The market possibilities for granule materials are already limited. Only large, well established firms could compete under existing conditions. One of these will open a plant in the southern California area. Development of a good source of slate in California would be desirable, as freight rates from the East run up local slate granule costs tremendously. The possibility of developing specially colored natural products, such as greenstones and red materials, should not be overlooked. Production costs have to be kept at a minimum. Current southern California prices on some raw materials are roughly as follows: crushed rock (mainly granite) - $5 per ton or less; crushed brick - $10 to $15 per ton; crushed dolomite - $10 to $15 per ton; and crushed slate - $20 per ton and over.

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NEW TALC PROCESSING PLANT

A new talc-grinding plant at Dunn, San Bernardino County, will be ready for operation in May. Talc, clay, bentonite, volcanic ash, and other non metallics will be processed. An all-steel building containing 6400 square feet will house new processing units of latest design. There will be a primary star-tooth roll crusher of 25 ton per hour capacity and a Raymond, highside, four roll mill in closed circuit with a Raymond Whizzer separator and bagging machines. Materials for the Raymond units will be dried by means of an oil fired, 1,800,000 BTU furnace. Storage bins for finished products will provide sufficient capacity for loading directly into railroad cars for bulk shipment. Facilities for bagging finished products will also be provided. Electrical power for operations will be supplied by two Fairbanks-Morse 96KVA diesel generators. Ample water is assured from a 200 foot well. The plant will be operated by Western Talc Company and will process materials from both the company's mines and other mines in the area.

NEW PUBLICATION

The July 1947 quarterly issue of the California Journal of Mines and Geology is now ready for distribution. This issue consists of "Limestone in California" by C. A Logan, and a five page statement and map regarding the status of topographic mapping in the United States (by the Map Information Office of the United States Geological Survey). "Limestone in California" is a 182 page comprehensive survey of the limestone resources of the State together with data on the origin and uses of limestone. A map showing the geographic distribution of limestone in California is included. Mr. Logan is District Engineer for the Sacramento Field District of the State Division of Mines.

Prices: One year's subscription (4 issues), $2.50; single issues, $0.75.

Olaf P. Jenkins, Chief
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MINERAL INFORMATION SERVICE

Vol. 1 May 1, 1948 No. 5

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

SOME COMMODITY STATISTICS FOR 1947

Borates

During 1947, a total of 508,637 net tons of borate materials were produced in California, as compared with 429,798 tons in 1946. This includes the sodium borate kernite (rasorite), and kramerite from Kramer District in Kern County; crystallized borax prepared by evaporation of brines from Searles Lake, San Bernardino County, and Owens Lake, Inyo County; and a small amount of colemanite from Death Valley, Inyo County.

Because the crude ore of borax is never sold as such, but is almost entirely refined into borax of commerce before shipping, and because these materials vary widely in boric anhydride content, the tonnage has been recalculated to a basis of 40% B_2O_3. This is approximately the average B_2O_3 equivalent of colemanite after calcining, also of crystallized borax obtained from evaporation of lake brines. Recalculated, the 1947 output totaled 382,054 net tons, valued at $9,029,422, as compared with 332,157 tons worth $7,230,925 in 1946. The 1947 output of borates is the largest in quantity and value reported in the state to date.

Dolomite

The dolomite reported shipped in California during 1947 totaled 298,138 net tons valued at $680,998 and came from a single property each in Inyo, Monterey, San Benito, San Bernardino, and Tuolumne counties. The 1947 value of output was the largest so far reported in the state.

Salt

Salt produced in California during 1947 amounted to a total of 817,481 net tons valued at $2,250,756; compared with 796,761 tons worth $2,274,722 during 1946. The 1947 output came from eleven properties in Alameda, Butte, Kern, Mono, Monterey, Orange, San Bernardino, and San Diego counties. The same properties which produced in 1947 produced in 1946, plus one additional deposit in Imperial County.

Most of the salt produced in California is obtained from solar evaporation of water of the Pacific Ocean. Plants are located on the shores of San Francisco, Monterey, Newport and San Diego bays. Additional amounts of salt are derived from lakes and lake beds and related rock salt deposits in the desert regions, mainly in San Bernardino, Kern, and Imperial counties. Salt has also been evaporated from an alkaline lake water in Modoc County. A small amount of salt is being obtained by evaporation of water at Mono Lake, Mono County and from a mineral spring in Butte County.

Soda

Sodium salts produced in California during 1947 included soda ash, and trona (sodium sesqui-carbonate-$Na_2CO_3.NaHCO_3 2H_2O$) from three plants on Owens Lake, Inyo County, and soda ash, trona, and salt cake (sodium sulfate) from two plants on Searles Lake, San Bernardino County. No shipments of salt cake were made from Durmid Hills, Imperial County; Dale Lake, San Bernardino County; or Carrizo Plains, San Luis Obispo County during the year.

Shipments during 1947 totaled 479,921 net tons worth $8,027,186, as compared with 362,015 tons worth $4,476,553 in 1946. Of the 1947 output, approximately two thirds was soda ash and trona and the remainder was salt cake, whereas in 1946 there were 201,271 tons of soda ash and trona and 160,744 tons of salt cake. The 1947 production is the largest ever reported in this state by a large margin.

NEW SPECTROGRAPH AND POLAROGRAPH

The State Division of Mines has recently received two valuable pieces of research equipment for use in the mineral investigations which are carried on by the Division. One is a grating-type spectrograph made by the Applied Research Laboratories. The other is a Heyrovsky-Shikata polarograph. Both are the gifts of Dr. John Herman of Los Angeles. The spectrograph is valuable for rapid and minute qualitative analyses and is particularly useful where only a small quantity of testing material is available. It will also give quantitative results within certain limits of error. The polarograph will give quantitative results down to thousandths of a percent. The machine received by the Division of Mines is one used by its inventor, Dr. J. Heyrovsky when he was in the United States. Dr. Heyrovsky is head of the Department of Physical Chemistry at Charles University in Prague, Czechoslovakia and is one of the foremost European physical chemists.

The Division of Mines is deeply indebted to Dr. Herman for these splendid pieces of equipment.

MINING AND INDUSTRIAL NEWS NOTES

New Titanium Pigment Plant in Los Angeles County

A new pilot plant for producing titanium pigment will be opened in the San Fernando Valley at Roscoe sometime in April. It will be the only one of its kind west of St. Louis, Missouri, and will utilize titanium concentrates produced locally. The plant is capable of processing three tons of ilmenite concentrate, with a minimum of 45% TiO_2, per day, and will produce a white pigment composed of 30% TiO_2 and 70% $CaSO_4$. The concentrates are digested in sulfuric acid and the resulting product is dissolved in water. Iron is crystallized out, hydrated lime is added, and the clarified solution is boiled to co-precipitate titanium hydrate and calcium sulfate. The precipitate is washed, then dried and calcined in one operation, the calcination taking place above 800°C. The titanium hydrate goes to titanium dioxide and the final calcined product is then pulverized to 325 mesh. It is then ready for bagging or other disposition. The plant will be operated by the San Gabriel Pigments Company, Mr. H. M. Morley, President.

New Perlite Operation

A plant for processing perlite for light weightaggregates is now in operation at Campbell, Santa Clara County. It was operated during 1947 on an experimental basis and limited production is reported for the first quarter of 1948. Full production is expected by the middle of June. The plant is operated by the National Perlite Company, Mr. A. G. Keating, President. Six men are employed.

COAL

Coal is a rock composed of a complex combination of hydrocarbons derived from plant remains that have accumulated and become buried under anaerobic conditions. Leaves, stems, roots, tree trunks, flowers, and even pollen grains have contributed to the deposits of the coal measures. Cannel coal, a rapid burning variety found in the Gulf Coast fields of Texas and Mexico, is made up almost entirely of pollen grains and spores of ancient plants. Coal forms under marshy conditions, usually in fresh water but sometimes in brackish water. The plant-remains gradually accumulate on the swamp floor under water, the water largely excluding the air and preventing oxidation of the cellulose. Periods of high water add clay and even clastic sediments to the peaty deposits so that sandy and argillaceous strata are commonly interbedded with the coal seams. Peat is the first stage in formation of some coal. Peat is merely an accumulation of plant fibers, under swampy conditions, without subsequent burial over a long period of time and without conversion of the cellulose fibers into other hydrocarbons by processes of carbonization. There are all grades of coal or semi-coal from peat to graphite. Graphite is pure carbon and is exceedingly inert except at enormously high temperatures. Coal, on the other hand, is a combustible substance in great demand as a fuel and as a source of hydrocarbons for many other uses.

Coal is divided into a number of varieties largely on the basis of its heat-producing qualities, coking ability, ash content, and stability during handling.

Anthracite is a partly metamorphosed coal characterized by its compact form, lustrous black color, conchoidal fracture, and maximum hardness (for coal - 2-2.5 on Moh's scale). Anthracite does not soil the fingers when handled as do most other coals and graphite. It burns slowly with a blue flame and without smoke, will not form coke, and has a lower calorific value than bituminous coal because of its lower content of readily combustible material (has a high fixed-carbon ratio).

Bituminous coal is less lustrous than anthracite and is softer and more laminated. It fractures into roughly cubical fragments and burns with a long, yellow flame and bituminous odor. Transitory types between anthracite and bituminous coal are termed semi-anthracite and semi-bituminous; transitory types between bituminous coal and lignite are termed sub-bituminous. Bituminous coal is further subdivided into coking and non-coking types. Coking coal has the property of softening and liquefying, at its critical decomposition point, and then, at higher temperatures, of giving off its volatiles as gas bubbles. The residue, under controlled temperature conditions, is a hard, cellular carbon known as coke.

Cannel coal is dull black in color, soils the fingers when handled, and is considerably softer than anthracite. Cannel coal has a high percentage of volatiles and can sometimes be lighted with a match. Like lignite, cannel coal does not ship well, tending to break down into small pieces with handling.

Lignite is, strictly speaking, a brown coal in which part of the cellulose has not been carbonized; hence is lignitic or woody. However, lignite has become a loose term for a wide range of impure, low grade coals of considerably less value than anthracite or bituminous coal. Lignite does not ship well and has a high ash percentage.

There are also several varieties of waxy or asphaltic semi-coals such as boghead coal, torbanite, and byerite; a group of resins related to coal such as ambrite and succinite-(amber); and the polishable coal-associate, jet. Carbonite is a natural coke produced by the action of igneous rocks upon coal beds.

Coal has been found in rocks varying in age from Devonian to Pleistocene. In North America, which contains the world's greatest coal reserves, coal is principally of Carboniferous, Cretaceous or Tertiary age; in Asia, which contains the second largest reserves, the main deposits are distributed in Carboniferous, Juratrias, Permian, and Tertiary rocks. California coal is principally of Cretaceous, Eocene, and Miocene age.

Coal is found in 42 counties in California but most of it is of inferior grade. Some sub-bituminous coal has been produced but most deposits are lignite. Coal production in California dates from 1861 when mines in the vicinity of Mount Diablo in Contra Costa County began to ship their product. The mines in Corral Hollow near Livermore, Alameda County began to produce in 1862 and the Tesla mine near Ione, Amador County in 1866. Thereafter, coal mining continued in considerable volume until the meteoric rise of the oil industry largely forced California coal from the market as a fuel. In addition to the three localities mentioned above, considerable coal was mined at Stone Canyon, Monterey County, the Eel River, Mendocino County, James and Larious Creeks, San Benito County, Elsinore, San Diego County, and Santiago and Silverado Canyons, Orange County. Since the 1890's coal has been mined spasmodically in several places in California for local use, there being a statewide flurry of activity at the beginning of World War I. Since World War II, there has been a resurgence of interest in California coal not so much as a fuel but for the waxes, pigments, coal tar derivatives, etc., which can be made from it. Two properties are already active, one at Ione Amador County and the other near Dos Rios, Mendocino County. The best reserves appear to lie in Mendocino, Monterey, San Benito, Amador, Alameda, Contra Costa, Shasta and Orange Counties, but it is probable that other areas can be developed if the demand arise

California coal mining has been mainly of underground type using ordinary coal mining techniques. One recently developed deposit in Mendocino County is being stripped for surface mining. Although many California veins dip too steeply to lend themselves to this type of exploitation, it is likely that large scale surface workings will be attempted on gently dipping strata in other areas.

Although California coal, as such, probably can never compete with other fuels except in localized areas, the outlook for it as a source of a variety of other product looks promising. With the gradual decline in the petroleum and natural gas output and the ever-increasing domestic and industrial demand for natural gas, the time will probably come when California coal will be converted to gas or to liquid fuel. Production of coal for extraction of montan wax and mineral pigments, and for briquettes, is already under way. Production of coal-tar products and many others will soon follow.

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ANTIMONY

Antimony, a metallic element, is tin-white in color and streak, and has a metallic luster. It is generally massive, lamellar and distinctly cleavable, with perfect basal cleavage and an uneven fracture. Antimony is very brittle and heavy (G. 6.65-6.72) but not very hard (H. 3.0-3.5), and crystallized in the rhombohedral system.

In small quantities, antimony is a common constituent of many minerals and ores but, as such, is of little importance. Native antimony has been found in California in El Dorado and Kern Counties, but the principal ore of antimony is stibnite, the sulphide.

Stibnite, or "antimony glance", Sb_2S_3, crystallizes in the orthorhombic system. It is lead-gray to dark-gray in color and streak and has a metallic luster. Cleavage is perfect and fracture is uneven. It is soft (H. 2.0) and of medium weight (G. 4.5-4.6). The most usual crystal habit is long prismatic. Crystals are often bent and curved and have striated and furrowed faces. Confused aggregates or radiating groups are common. Antimony is seldom massive or granular.

Stibnite usually is deposited from alkaline solutions in intimate association with quartz. A common association is beds or veins in granite and gneiss together with its alteration minerals. In metalliferous deposits it is associated with sphalerite, galena, cinnabar, barite, and quartz. It sometimes accompanies native gold. Stibnite itself may be auriferous or argentiferous.

The principal production in California has come from Kern, San Benito, and San Bernardino Counties. T he total California production from 1887 through 1945 has been only 2647 tons. None was shipped in 1945 and only a very small amount (from Inyo and Kern Counties) during 1944. California ores have run 40% to 50% antimony as compared to 60% for imported ores.

Stibnite fuses readily, coloring the flame greenish-blue. In the open tube it gives off sulphurous and antimonial fumes, the latter condensing as a white sublimate. It fuses on charcoal and gives off oxide fumes which coat the charcoal. When pure, it is soluble in HCl, and in HNO_3 it is decomposed with separation of antimony pentoxide (which is insoluble in water). Stibnite is readily distinguishable from other sulphides such as galena by its softness, cleavage and fusibility. It is harder than graphite.

Some other antimony minerals found in California are kermesite, Sb_2S_2O; valentinite, Sb_2O_3; cervantite, $Sb_2O_3.Sb_2O_5$; stibiconite, $H_2Sb_2O_5$; and stibiotantalite, $Sb_2O_3(Nb,Ta)_2O_5$. None of these are of economic importance in California.

There is only one antimony smelter operating in California. T his is the Harshaw Chemical Company plant at El Segundo. They process a sulphide concentrate making both antimony oxide and refined antimony metal.

Antimony, when alloyed with varying amounts of copper, lead or tin, is used extensively in the manufacture of antimonial lead, battery plates, bearing metals, and type metal. It is adaptable to the latter because of its property of expanding upon cooling from a molten state.

Antimony oxide is used in the paint and ceramic industries. During wartime, the manufacture of fire-retardant paint and the flame-proofing for fabrics consumed large quantities of the oxide.

The tables below give the approximate percentage of antimony used, either in metallic or oxide form, for several products during 1945:

Metal	
Antimonial lead	47%
Bearing metal	22%
Battery metal	10%
Type metal	10%

Oxide	
Flame-proofed fabrics	58%
Paints and lacquers	23%
Frits and ceramic enamels	7%

The present market is good as antimony is in demand. It is one of the metals on the deferred tariff list. The current (January, 1948) prices for antimony ore are based on short ton units:

50-55 percent	\$4.40 @ \$4.45	per unit of antimony contained
58-60 "	\$4.50 @ \$4.60	" " " " "
60-65 "	\$4.60 @ \$4.70	" " " " "

The refined metal (99½ percent pure) brings 36.12 cents per pound, boxed in lots of 10,000 pounds or more, New York, or 33 cents, bulk, f.o.b. Laredo, Texas.

The United States produces approximately 8 percent of the antimony it uses, based on 1945 figures. Most of this production was contained in concentrates recovered from ores mined primarily for other metals, such as gold and tungsten.

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MAGNESIUM

Magnesium (Mg) is a silvery-white, brittle, metallic element with chemical properties intermediate between calcium and zinc. It has an atomic weight of 24.3, a sp. gr. of 1.74, a valence of 2, and a melting point of 651°C. The metal is malleable and ductile when heated and, in thin pieces, burns fiercely in air. Because magnesium is one of the lightest of the common elements, it found a wide use during the war in the aircraft industry where lightness combined with strength is essential. Now that magnesium is available to other industries it will undoubtedly be adapted to many other uses such as automobile manufacture.

Metallic magnesium does not occur in nature. However, several of its compounds are found in exploitable quantity and are marketed both for conversion to the metal and for other purposes.

The best known magnesium compound is the carbonate magnesite ($MgCO_3$). Magnesite often contains iron and calcium as impurities. Ordinarily it is white to yellowish, but if a high percentage of impurities are present it may be brown or even black. It belongs to the rhombohedral carbonate group, is brittle, has a hardness of 3.5 to 4.5, and a sp. gr. of 3.0 to 3.1. It occurs either as coarse, crystalline masses resembling calcite or dolomite, or as dense, fine grained, white amorphous masses exhibiting conchoidal fracture.

Dolomite ($CaCO_3.MgCO_3$) is ordinarily light colored but may be any color depending upon the impurities present. White, pink, yellow, green, brown, and black dolomites have been described. It grades into both calcite and ankerite. Dolomite will not effervesce in dilute acids as will calcite.

Two salines are important sources of magnesium and its salts. These are kieserite ($MgSO_4.H_2O$) and carnallite ($KCl.MgCl_2.6H_2O$). They are common in some rock salt deposits and in lake and ocean brines, from which the pure minerals can be separated by fractional crystallization.

During the wartime demand for magnesium, a deposit of almost pure antigorite serpentine near Rawhide, Tuolumne County, was thoroughly prospected as a possible source of the metal. Although it was pronounced an excellent deposit, development never took place.

In California, amorphous magnesite is found in association with serpentine in the Coast Ranges from Mendocino to Santa Barbara County, and in the Sierra Nevada foothills from Placer to Kern County. It is also found in Riverside County in veinlets cutting serpentine and in San Bernardino County in vein replacements in limestone. Sedimentary magnesite has been described in Kern County interbedded with clay. These deposits have been important in the past but are now, for the most part, idle.

Dolomite is found in fourteen counties of which the most important are Inyo, Monterey and San Bernardino. Carnallite and kieserite are unknown in California although magnesium salts are recovered from sea water at Moss Landing, South San Francisco, Newark, and San Diego.

Metallic magnesium is prepared from magnesite by the Hansgirg process, from sea water by the Dow electrolytic process, and from dolomite by the ferrosilicon process. Great strides in magnesium reduction and refinement from its ores were made during the last war emergency. Largely as a result of curtailment of imports of magnesite during the war, much artificial magnesite is now produced by precipitation from sea water with calcined oyster shells.

Metallic magnesium is used in pyrotechnics, incendiary bombs, photoflash appliances and allied devices where its highly inflammable properties are desired. Alloyed with other lightweight metals it is gaining wide favor for use in lightweight castings and in sheet and shaped forms.

Magnesium salts have long been used in pharmaceuticals in sulfate, hydroxide, citrate and other forms. Calcined dolomite is used in the steel industry for open hearth furnace bottoms. Magnesite is also used as a refractory material both in open hearth and reverberatory furnace linings. Dead burned magnesite, which is calcined at a high temperature and contains less than 1% CO_2, is used in granular form for furnace floors. It is also made into basic refractory brick alone or together with chrome, zirconia and other refractories. Caustic magnesite is calcined at a lower temperature and contains from 4 to 7% of CO_2. With magnesium chloride, magnesite is made into oxychloride (sorel) cement. This is a very durable material used in artificial building stone, tiles, and floors and as a binder in the manufacture of grindstones, emery wheels and polishing wheels. Magnesite is also used in the manufacture of rubber, rayon, and paper; as a fertilizer; and as a raw material for making other magnesium compounds. Basic magnesium carbonate is an insulating material used for pipe and boiler coverings.

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MINERAL INFORMATION SERVICE

Vol. 1 June 1, 1948 No. 6

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

SOME COMMODITY STATISTICS FOR 1947

Gypsum

Gypsum produced in California during 1947 totaled 809,934 net tons valued at $2,062,574, as compared with 618,007 tons worth $1,431,884 in 1946. The 1947 output came from six properties in Kern County; two properties in Riverside County; and one property each in Fresno, Imperial, Kings, and Ventura Counties. Three of the properties in Kern County, one of those in Riverside County, and the one in Kings County were new operations and did not report shipments in 1946. The property reporting production from Monterey County in 1946 was idle during 1947. An additional production of calcium sulfate, from Alameda County, was made as a by-product of a chemical process of precipitation of magnesium hydroxide from sea water bitterns. Figures for this output are not included with those of natural gypsum.

The 1947 output of gypsum was the largest in quantity and value ever reported in California, and for the fifth consecutive year an increase has been recorded.

Silica (Quartz and Glass Sand)

Silica, including quartz and glass sand, produced in California during 1947 totaled 358,942 net tons worth $997,984. This was a decrease in both quantity and value as compared with 1946, when the output was 594,155 tons worth $1,408,553.

Of the 1947 output, glass sand came from two producers in Monterey County, and one each in Riverside and San Diego Counties.

The quartz came from an established property in San Bernardino County and a new producer in Kern County. Operators reporting production in 1946 and not in 1947 included a producer of glass sand in Contra Costa County and two producers of quartz, one in Mariposa County and one in San Bernardino County.

Slate

Slate produced in California during 1947 totaled 13,010 net tons valued at $80,106 and came from a single property each in El Dorado, Inyo, Mariposa, Placer, and Tuolumne Counties. The 1947 output showed a marked increase over that of 1946, in which year a single property each in El Dorado and Placer Counties was productive.

The slate from El Dorado County was used as roofing granules and as a filler; that from Inyo County as a filler, and the material from the other counties was sold in crude slabs to be used as flagstones or as building facings.

NEW PUBLICATIONS OF THE DIVISION OF MINES

Three issues of the CALIFORNIA JOURNAL OF MINES AND GEOLOGY are now being distributed.

Vol. 43, no. 4, the October 1947 issue, contains the "Annual Report of the State Division of Mines" for 1947 by Olaf P. Jenkins; "Mines and Mineral Resources of Siskiyou County" by J. C. O'Brien; "Silver" by W. B. Winston; and "Pumice" by W. B. Winston. The annual report summarizes the activities of the Division of Mines for 1947 and the condition of various mineral industries for the year. It is an important annual statistical summary. "Mines and Minerals of Siskiyou County" is a comprehensive survey of mining activities in that county with special reference to individual deposits. Mr. O'Brien is District Mining Engineer for the Redding Field District. "Silver" and "Pumice" by W. B. Winston, Junior Mining Engineer for the State Division of Mines, are library-research papers treating with descriptions, occurrence, processing, use, and market information on each of the above mineral commodities.

Vol. 44, no. 1, the January 1948 issue, includes three articles on various aspects of the foundry sand industry with special emphasis on California. "Trends in the California Foundry Sand Industry," by Leonard O. Hofstetter, Vice President of the Southern California Chapter, American Foundrymen's Association, briefs the general picture of the California casting industry in regard to foundry sands. "Properties of Foundry Sands" by Heinrick Ries, Chairman, Sand Division, American Foundrymen's Association, is a comprehensive summary of the physical properties of foundry sands in general. "California Foundry Sands," by Lauren A. Wright, Associate Geologist, State Division of Mines, is a complete survey of the foundry sand deposits of California.

In addition to the above items on foundry sand, the January release includes a library-research paper by W. B. Winston, Junior Mining Engineer, State Division of Mines, entitled "Uranium." Description, occurrence, production, prospecting, mining, marketing, use, and history of uranium are discussed.

A reprint of the "Manner of Locating and Holding Mineral Claims in California" by A. H. Ricketts (Revised by C. A. Logan) is included in this issue. Demand for this summary has been heavy.

Vol. 44, no. 2, the April 1948 issue, includes an important geological survey of the basement rocks of the Great Valley of California and their relationship to the oil pools. This work is entitled "The Basement Complex in Well Samples from the Sacramento and San Joaquin Valleys, California" and is written by J. C. May and R. L. Hewitt of the Tidewater Associated Oil Company.

"The Mines and Mineral Resources of Napa County" by Fenelon F. Davis is a recent survey of mineral commodities in that county. Mr. Davis is Assistant Mining Engineer for the State Division of Mines.

"Soda Ash and Saltcake in California" by Clarence R. King is an analysis of the industrial aspects of two very important industrial minerals. Mr. King is Associate Metallurgical Engineer for the State Division of Mines.

A reprint of "The Lakes of California" by William Morris Davis, originally published in the Journal in 1933, is part of the April issue. Public demand for this paper has been great. Dr. Davis, who passed away since this article was first printed, was Professor Emeritus of Geology at Harvard University and former Professor of Geology at the California Institute of Technology.

SODIUM

Sodium (Na) is a soft, silvery-white, metallic element having an at. wt. of 23, valence of 1, m. p. of 97.5°C, and sp. gr. of 0.97. It is one of a group of alkali-forming metals which includes potassium (K), magnesium (Mg), calcium (Ca), and several others. Sodium is the seventh most abundant element in the earth's crust and the second most abundant alkali metal. Native sodium is unknown; it always occurs in nature combined with other elements. Contact between the metal and water results in violent decomposition of the water with formation of hydrogen gas and sodium hydroxide (NaOH). Sodium is spontaneously combustible in air and burns to the white powder sodium peroxide (Na_2O). Metallic sodium is used in chemical reduction of organic compounds; in preparation of sodium peroxide and sodium cyanide (NaCN); and as a liquid alloy with mercury in some gold-extraction processes.

As a great many sodium compounds are exceedingly soluble in water, they tend to become concentrated in sea water and in lakes which have no outlets. Consequently, the chief natural sources of sodium chemicals are marine and salt-lake brines or sedimentary beds formed by evaporation of such brines. Sodium is present in sea water principally in chloride and sulfate form. Lake brines may contain large quantities of sodium carbonate as well as sodium chloride and sodium sulfate. Enormous quantities of sodium are present in the non-water-soluble primary minerals of igneous rocks, but it is usually not profitable to extract industrial alkalies from such sources.

Trona ($Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$) is one of the important natural sources of sodium carbonate. A large deposit of this mineral is now being developed at Green River, Wyoming. Trona is a gray to yellowish-white transluscent carbonate having one perfect cleavage and a vitreous, glistening luster. It is a soft, light-weight, bitter-tasting mineral occurring in plates, fibrous veins, or columnar masses. Trona is one of the principal sources of sodium carbonate at Searles Lake and is found in some other California salt lakes.

Natron ($Na_2CO_3 \cdot 10H_2O$), also known as washing soda or sal soda, is another major mineral of the Searles Lake deposit, occurring principally in solution in the lake brines, but occasionally in the crystallized portions which have not been exposed to air. It forms flat, diamond-shaped, monoclinic, colorless crystals which quickly effloresce into the monohydrate thermonatrite ($Na_2CO_3 \cdot H_2O$) when exposed to air.

Halite (NaCl) or rock salt is the commonest of the soluble sodium minerals. It is a constituent of all lake and ocean brines and is common in bedded sediments of both lake and marine origin. Halite usually crystallizes in colorless or white cubic aggregates. Skeletal crystals are common; cleavage is cubic. Halite has the characteristic taste of table salt and is not bitter like carnallite and sylvite.

Mirabilite ($Na_2SO_4 \cdot 10H_2O$) or Glauber salt is a colorless transparent mineral which crystallizes in large needle-shaped crystals. Its solubility in water increases rapidly with any rise in temperature. Like natron, mirabilite crystals readily effloresce even in dry air and hence usually are found only in saturated brine solutions. Mirabilite has a cool, weakly saline taste which gives a bitter after-effect.

Thenardite (Na_2SO_4) commonly occurs in platy or thick-bladed penetration twins. Cruciform and wedge-shaped aggregates are common. Thenardite is fairly stable in dry air and is often the alteration product of mirabilite. Crystals may be clear-transparent to brown-transluscent. Thenardite has a fairly saline taste and is exceedingly soluble in water.

Other sources of sodium compounds at Searles Lake and some other California deposits are Glauberite ($CaSO_4 \cdot Na_2SO_4$), hanksite ($9Na_2SO_4 \cdot 2Na_2CO_3 \cdot KCl$), pirsonite ($CaCO_3Na_2CO_3 \cdot 2H_2O$), and gaylussite ($CaCO_3 \cdot Na_2CO_3 \cdot 5H_2O$).

Sodium chloride or common salt ($NaCl$) is the main raw material upon which the sodium-chemical industry is based. The three next most important sodium compounds are salt cake (Na_2SO_4), caustic soda ($NaOH$), and soda ash (Na_2CO_3). Eastern manufacturers depend almost entirely upon salt as the raw material from which these and other sodium compounds are made. The eastern supply comes largely from salt wells which tap subsurface beds of rock salt. Some salt is produced in the southern states by solar evaporation of sea water. Michigan, New York, Ohio, Kansas, Louisiana, and Texas are the leading eastern producers of salt. In the western states, a considerable percentage of the sodium salts are produced directly from natural concentrations in lake brines. A large tonnage of salt and small quantities of other sodium compounds are recovered from ocean water. Concentrated brine is obtained by solar evaporation and the various dissolved chemicals are separated by fractional crystallization.

California is unusually rich in water-soluble sodium minerals, but only a few of the many concentrations are being exploited at the present time. Most of the salt produced in California comes from sea water. Some lake brines contain deleterious chemicals such as arsenic compounds which cannot be separated from salt at a cost which would allow for present competitive prices. Natural sulfates and carbonates were recovered from only two localities in California in 1947. Inaccessibility of many deposits, highly competitive markets, and current high operating costs are barriers to expanded production.

Searles Lake, San Bernardino County, and Owens Lake, Inyo County, are the present principal sources of natural sodium sulfate and sodium carbonate in California. Enormous untouched reserves exist in Death Valley and Deep Springs, Inyo County, Alkali Lake Mono County, Annie Lake, Modoc County, Honey Lake, Lassen County, and Soda Lake, San Bernardino County. Small amounts of salt and associated alkaline compounds have been taken from Durmid Hills, Imperial County, Dale Lake, San Bernardino County, Carrizo Plain, San Luis Obispo County, and Mono Lake, Mono County. Properties at those locations were idle during 1947, but reserves have hardly been scratched.

Sodium salts are produced from brines by fractional crystallization under closely controlled conditions of temperature, pressure, and brine concentration. Different compounds crystallize out under different physico-chemical conditions, but crystallizing properties of some minerals are so nearly alike that close controls are necessary to produce pure products. In some processes, CO_2 gas is bubbled through the brine concentrate to aid in crystallization of the carbonate components of the brine. Small tonnages of crystallized alkaline compounds are occasionally mined and marketed without further refinement. However, most of the chemicals are pumped from the deposits in brine form and are not processed from crystalline material.

Soda ash is consumed chiefly by the glass, ceramic, and soap industries and by manufacturers of caustic soda and other sodium chemicals. Smaller amounts are used by paper pulp, aluminum, textile, and petroleum industries. Saltcake is used as a substitute for soda ash in many industries because of current shortages in soda ash. Wood pulp, glass, and chemical-manufacturing industries are major consumers of saltcake; minor consumers are the tanning, dyeing, pharmaceutical, and fertilizer industries. Caustic soda is used principally in the manufacture of soap and as a neutralizer of acid. There are countless minor uses for a wide variety of other sodium chemicals.

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CLAY

Clay is a soft, plastic material composed principally of hydrous aluminum silicate. It is usually made up of one or more fine-grained, scaly minerals such as kaolinite ($2H_2O \cdot Al_2O_3 \cdot 2SiO_2$), montmorillonite ($(Mg,Ca)O \cdot Al_2O_3 \cdot nH_2O$), and anauxite ($Al_2O_3 \cdot 3SiO_2 \cdot 2H_2O$). Some fire clays contain bauxite ($Al_2O_3 \cdot 2H_2O$). The value of a clay depends mainly upon its physical properties; chemical composition is of less importance. Plasticity, tensile strength, color, and fusibility are the physical characters upon which the usage is based.

Clays are classified into a number of varieties based on physical characteristics. Kaolin is a trade name for a wide variety of white clays suitable for tile, porcelain, and paper filler. It is white and exceedingly plastic. A purified product is obtained by washing the raw material and collecting the suspended particles in settling tanks. China clay and paper clay are kaolins which are selected and handled depending upon the desired special use; i.e., specifications of clay for paper filler would not be as exacting as clay for coating calendered paper.

Slip clay has a high percentage of impurities which will fuse readily and hence is suitable for use as a glazing material. It is mixed with water and sprayed on the outside of articles to be glazed. Slip clay is better than most artificial glazes except that it seldom gives a white finish.

Ball clay is a very plastic, white burning variety which is used primarily to add plasticity to less plastic clays and to other ceramic materials. Ball clay is usually of marine origin but may be deposited in lakes and swamps. It contains from 45 to 60% silica and 32 to 37% alumina. Ball clay is used in manufacture of white earthenware, porcelain, tile, glass refractories, and graphite crucibles.

The term fire or refractory clay covers a wide variety of clay substances which will burn to a high-strength, heat-resistant product for use in fire brick and related refractory articles. Refractory clays are divided into several varieties on the basis of fusibility. The better fire clays fuse above 3000°F. Flint clay is a type of fire clay which has a flint-like structure, conchoidal fracture, and low plasticity. Other types of clay are mixed with it to give added plasticity. Although primarily for fire-resistant uses, fire clay is also employed in the manufacture of terra cotta, paving brick, portland cement and many other items.

Fullers earth is a clay product of wide range in chemical composition which has a high adsorbent power for basic colors and hence is in considerable demand as a decolorizer of oils and other liquids.

Bentonite is a clay product which has a tremendous capacity for adsorbing water. It is an alteration product of volcanic ash or tuff of intermediate chemical composition. Highly acidic (rhyolite) and strongly basic (olivine basalt) tuffs do not alter to bentonite except under rare conditions. Bentonite is used in filters, water softeners, and as an absorbent and dehydrator.

In addition to the aforementioned broad categories into which clay is classified, dozens of sub-varieties could be described for special purposes which must meet special requirements. Elaborate physical tests are often necessary to establish the value of a clay deposit for a particular use.

Clays are always alteration products of pre-existing minerals, principally feldspars. They may be residual or transported in relation to the position of the parent or source rock. Some clays form by residual alteration of massive feldspar bodies by hot, rising, aqueous solutions; other residual deposits are merely the end products of surface or near-surface weathering by meteoric water. Transported clays may accumulate in river systems, in ocean basins, in lakes and swamps, or beneath glaciers.

They may be nearly pure or mixed in all proportions with detrital sediments. Clay strata are often associated with coal measures, usually in the form of laminated fire-clay. C lay shales are widely used in portland cement and in clay mixtures for ceramic purposes where high plasticity is not requisite. California ceramic clays are principally of Eocene and Cretaceous age. Some clay shales of other ages than the Cretaceous or Eocene have been utilized.

Clay is mined, for the most part, in open pits. Underground mining is resorted to only in case of very high grade deposits or else in connection with large, favorably situated bodies. Inasmuch as clays tend to "work" or crawl when wet, underground mining is either unsafe or prohibitively expensive except in dry workings or where a strong, watertight overburden exists.

California clay deposits are widespread and include many of superior grade. The three principal clay-producing centers are Lincoln in Placer County, Ione in Amador County, and Alberhill in Riverside County. Material suitable for fire brick and some kinds of dinnerware is found at these localities. Extensive undeveloped reserves of high grade gray, white, and colored clay occur in Nevada, Yuba, and southern Sierra Counties. These are interbedded with Eocene sands and gravels in many of the old hydraulic diggings. Utilization of low grade clay is largely a function of accessibility to markets coupled with the vagaries of supply and demand. Countless deposits of low grade clay have been worked from time to time in California, mainly for use in common brick, and then abandoned for reasons other than unsuitability of the product or exhaustion of the deposit. Conversely, new deposits are continually being opened in more strategic spots. Pottery-grade clay was produced in 17 counties in 1946 and clay for brick and hollow tile in 16. Washing and settling methods have been developed which enable production of very high grade pottery and china clays from material which once would have been considered unsuitable.

Bentonite, in California, is mined chiefly in the desert regions of Inyo, Kern, and San Bernardino Counties. New deposits are still being discovered from time to time; one was made south of the Newberry and Ord Mountains, San Bernardino County, at a recent date. Bentonite is in considerable demand for use in oil well drilling mud and severql types of filters. Fullers earth has been mined in Calaveras, Solano, Riverside, Fresno, Inyo, and Kern Counties but some of the deposits are currently idle.

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MINING AND INDUSTRIAL NEWS NOTES

Basic Refractory Brick Plant in Monterey County

The only plant making basic refractory brick in the west is operated by Permanente Metals Corporation at Moss Landing, Monterey County. This is one of California's war-born industries that continues to operate at capacity in peacetime. The raw material used is highly refractory magnesium oxide which is produced in an adjoining plant by treating sea water with calcined dolomite. The dolomite is quarried at Natividad, Monterey County. In addition to magnesia brick, the organization makes refractory brick containing high and low percentages of chrome. Refractories of various sizes and shapes for use as furnace linings are manufactured as well as standard sizes of brick. Permanente Metals Corporation also sells magnesium oxide and dolomite to other concerns.

Recent Activity in Gold Mining in Shasta County

Lessees at the Yankee John Mine, located six miles southwest of Redding, are crushing some very rich gold ore in a hand mortar and recovering the free gold by panning. The gold occurs in the cracks of a fractured quartz vein on the 100-foot level south of the shaft. It was found by the lessees after spiling through caved ground to reach an area beneath an underhand stope which had been excavated from the 66-foot level. The vein is about 18 inches wide, strikes S. 40° E. and dips 70° E. Both walls are greenstone. The gold is associated with calcite, pyrite, and arsenopyrite, and about an ounce of silver accompanies each ounce of gold. About two tons of ore in which gold can be seen by the naked eye is awaiting treatment. The Yankee John mine has been worked since last November by Sidney Smith and Norman Lane. The property is owned by Mrs. W. L. Hill of Summit City and is developed by a vertical 300-foot shaft and several hundred feet of drifts.

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MINERAL INFORMATION SERVICE

Vol. 1 July 1, 1948 No. 7

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

MINING AND INDUSTRIAL NEWS NOTES

A Basic Refractory Brick Plant at Los Angeles

Since release of the June 1 issue, the Division of Mines has been informed that the General Refractories Company plant at Los Angeles, one of 23 plants operated by this company throughout the United States, has been manufacturing basic refractory brick since April 1947. Using the standard Ritex process, both unburned chrome-magnesite and magnesite-chrome bricks are produced in standard and specialty sizes. Foreign chrome is imported and magnesium oxide is obtained from domestic plants which make it from dolomite and sea water. Magnesite is a raw material shipped in from Washington. Chrome-magnesite or Ritex "C" brick goes chiefly to the open hearth steel industry; magnesite-chrome or Ritex "A" brick goes to the glass industry as checker brick and other forms. The plant also produces silica bricks, fire clays, and bonding mortars; a number of specialty products utilizing sillimanite materials, and a line of standard sillimanite brick products.

New Gold Dredging Operation in Siskiyou County

A contract has been let to build a power line from Thompson Creek to Reeves Ranch in Siskiyou County, a distance of 6½ miles. The line will furnish power for the bucket-line dredge now being assembled on the Klamath River about a mile above Happy Camp by the Reeves Ranch Dredging Company. The dredge will have 68 buckets of 4 cubic feet capacity and will be capable of digging to a depth of 23 feet. It will handle about 3000 yds. of gravel in 24 hrs. A crew of 12 to 15 men will be under supervision of Harold C. Young, dredgemaster.

Calaveras County Fair Mineral Exhibit

The mineral exhibit at the recent Calaveras County Fair was judged May 14-15. The best county exhibit was made by Frank Tower, owner of the Royal mine, located near Copperopolis. It was in the newly-mined gold ore class. The display of large nuggets from the Ruby mine near Alleghany was spectacular and received a special award. Wildberg Brothers Smelting and Refining Company had a gold bar on exhibit. A prize was awarded to the person who came closest to estimating the value of it.

An attractive and appropriate exhibit of early devices used in recovering gold was set up on the grounds. These included gold pans, ground sluices, hand rockers, long toms, Chinese water wheels, and stamp mills.

NEW "MINERALS OF CALIFORNIA"

Bulletin 136, "Minerals of California" by Joseph Murdock and Robert W. Webb, is now in press and will be ready for distribution within the next month. There are approximately 400 pages of text and four full-page colored plates. The frontispiece is a beautifully colored photograph of a specimen containing benitoite, neptunite, and joaquinite in a matrix of natrolite. One colored page will be devoted to gold nuggets and two to pegmatite gems of San Diego County. The minerals will be arranged in alphabetical order for simplicity.

The first descriptive list of California minerals was published in 1866 by W. P. Blake . It listed 77 mineral species covering 31 pages. In 1884 a list was compiled by H. G. Hanks, then State Mineralogist, which included 135 mineral species. A. S. Eakle compiled a list in 1914 of 352 California species, and his revision in 1923 swelled the list to 417. Bulletin 113, written by Professor Adolph Pabst of the University of California and published in 1938, described 446 species. It was largely a revision of Eakle's work. Bulletin 136, which has been completely rewritten, includes 516 mineral species, a bibliography of 2000 titles, 400 pages of text, and historical and geological sketches of California's most famous mineral localities. The introductory paragraphs describe the mode of formation of rocks and minerals and other interesting sidelights on the minerals listed.

DOMESTIC URANIUM PRODUCTION PROGRAM

The United States Atomic Energy Commission has announced a three-point program to stimulate discovery and increase production of domestic uranium. The Federal Government has guaranteed minimum prices for a ten-year period covering refined uranium oxide, high grade uranium ore, and mechanical uranium concentrates. It has offered a bonus of $10,000 for each discovery leading to production of ore to the amount of 20 short tons assaying 20 or more percent of U_3O_8, and has guaranteed, for a three-year term, minimum prices for low-grade carnotite and roscoelite-type uranium-vanadium ores from the Colorado plateau area. Two vanadium-uranium plants will be operated by the government in that region for processing that type of ore. One is located at Monticello, Utah, and the other at Durango, Colorado.

Although uranium in deposits on U. S. public lands is reserved for the use of the Federal Government by authority of the Atomic Energy Act of August 1, 1946, the Commission encourages prospecting for new deposits of uranium ores on the public domain and on privately-owned lands. To mine uranium on privately-owned lands, a license is required from the Atomic Energy Commission. The Department of the Interior will validate locations of uranium deposits on public lands if they occur in association with other valuable minerals. In the unlikely event of discovery of uranium unassociated with other valuable minerals, the Commission will take steps to protect the prospector's equity.

Minimum price for domestic refined uranium compounds, high-grade uranium-bearing ores, and mechanical concentrates has been set at $3.50 per pound of recoverable uranium oxide (U_3O_8) less the cost per pound to refine to purity required by the Atomic Energy Commission after assay of a representative sample. The established minimum price is for small lots. Higher prices may be established by negotiation with the AEC for large-quantity operations and for ores containing recoverable amounts of other valuable minerals such as gold, silver, radium, thorium, vanadium, etc. Higher prices are dependent upon conditions of transportation, milling, and other applicable items.

Circulars describing the new policies in detail are available without cost from the Atomic Energy Commission's headquarters, Washington 25, D. C.; the AEC branch office at Junction City, Colorado; or AEC office, 70 Columbus Ave., New York, N.Y.

LEAD

Lead is a very malleable and somewhat ductile metallic element. It is lead-gray in color, soft (H 1.5) and heavy (G 11.4). Rarely occurring native, it is obtained from the ore minerals galena, lead sulphide; cerussite, lead carbonate; and anglesite, lead sulfate. Minor ore minerals are wulfenite, lead molybdate, and pyromorphite, lead phosphate and chloride.

Galena, PbS, is lead-gray in color and streak with a metallic luster. It crystallizes in the isometric system, commonly in cubes; is generally massive, cleavable, and coarse to fine granular; and is sometimes fibrous or plumose. The cleavage is cubic and highly perfect. Galena often contains silver and gold and frequently is a valuable silver ore mineral. When pure, it contains 86.6% lead.

Cerussite, $PbCO_3$, is an alteration product of galena usually found in the oxidized zone. It is white, gray, grayish-black or brown in color with a colorless streak. Luster is adamantine through resinous to vitreous or sub-metallic. Crystallizing in the orthorhombic system, often with simple tabular or prismatic crystals grouped in clusters and aggregates, it is rarely fibrous but often massive and compact. It is very brittle; has a hardness of 3-3.5; and a specific gravity of 6.46-6.57. When pure, it contains 77.5% lead.

Anglesite, $PbSO_4$, is also an alteration product of galena in the oxidized zones. Crystallizing in the orthorhombic system, the crystals are sometimes tabular, but more often prismatic in habit. It is also massive, granular to compact. Softer than cerussite, H 2.7-3, it is also very brittle. The gr. is 6.3-6.39; the color is white, yellow, gray or brown, with usually an adamantine luster; and the streak is uncolored. When pure, anglesite contains 68.3% lead.

Lead compounds produce metallic globules of lead when fused with sodium carbonate on charcoal in a reducing flame. A yellow oxide coating is left near the assay and a bluish-white coating farther off. Galena gives off sulphur dioxide when roasted in the open tube. Cerussite is soluble in warm dilute nitric acid with evolution of carbon dioxide gas. Anglesite is difficultly soluble in nitric acid.

No significant reserves remain unexploited in the United States because of technologic difficulties, , owing to the efficiency and universal application of the recovery methods for lead. Lead is taken from its ores by roasting and reduction methods in both blast and reverberatory furnaces.

Ores, both sulfide and oxidized (oxides and carbonates), containing gold, silver, or other valuable metals, are best treated in the blast furnace. The charge consists of the ore, coke and fluxes. The lead, with the silver, gold, etc., separates as "base bullion"; the sulphur, copper and iron, with some lead, forms matte, and the remaining bases with the silica form slag. Special fluxes may be necessary to form a suitable slag.

The base bullion is refined by pyrometallurgical or electrolytic methods, or a combination of these methods. Refined lead, gold, and silver, antimonial lead, and other marketable metal products are thus produced. The matte produced in the lead blast furnace may be treated at the lead smelter, but is usually shipped to a copper smelter for reduction to crude, "blister" copper, which is subsequently refined. The slag resulting from the smelting of lead ores contains, in addition to the silica, iron, and fluxes, the major portion of any zinc present in the ores treated. The presence of zinc requires comparatively large amounts of fluxes to insure a fluid slag and avoid entrainment of valuable metallic constituents in the slag. For this reason all custom smelters penalize the presence of zinc in lead ores above a certain percentage, usually 6 to 8%. Most lead smelter slags contain 6 to 7% of zinc, and in recent years the comparatively high price for zinc has stimulated the commercial recovery of zinc from lead blast furnace slags by volatilization methods (slag fuming plants).

High grade non-siliceous ores, containing little silver, are best treated in the reverberatory furnace in two stages, oxidation and reduction. The finely ground ore is first roasted on the hearth for several hours at temperatures of 500° to 600° C. Here part of the galena is oxidized to lead oxide or sulphate, the remainder being unaltered. The temperature is raised to 700° C, where the oxide and sulphate react with the sulphide, which acts as a reducing agent, producing metallic lead. The process may be repeated several times before the greater part of the lead is obtained. The slag residue can be treated in the blast furnace.

A number of areas contain reserves of lead ore in the United States, two important areas being southeastern Missouri and the Coeur d'Alene district of Idaho. The important California deposits are in the desert mountain ranges of Inyo County and are replacement bodies in Paleozoic or older limestones. Lead ores are often found in calcareous or dolomitic rocks and were generally deposited at moderate depths by solutions of relatively low temperature. Frequently, especially in the western states, lead and zinc ores occur together.

The physical properties of lead make it an extremely useful metal, and only zinc and titanium oxides in some pigments and some plastic for cable-covering have been successfully substituted for lead or its compounds. Lead is used principally for storage batteries, pigments, cable covering, solder, building supplies, ammunition, manufacture of tetraethyl lead for gasoline, and foil.

Lead is in short supply in the United States, and current figures (June, 1948) indicate a monthly consumption of at least 90,000 tons of primary and secondary lead. On April 5th, the domestic price was raised 2½¢ to 17½¢ per pound to meet the increased world prices and to stimulate production.

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LIST OF LATEST COMPLETE DIVISION OF MINES REPORTS ON CALIFORNIA COUNTIES

County	Report	Price	Remarks
Alameda	Oct. '29	Out of print	
Alpine	Oct. '31	$ .40	
Amador	Apr. '27	.30	
Butte	Oct. '30	.40	
Calaveras	July '36	.60	
Colusa	July '29	.30	
Contra Costa	Jan. '27	.30	
Del Norte	July '25	Out of print	
El Dorado	July '38	.60	
Fresno	July '29	.30	
Glenn	Oct. '29	Out of print	
Humboldt	Oct. '41	.60	
Imperial	Apr. '42	.60	
Inyo	Oct. '38	Out of print	New rept. being prepared
Kern	Jan. '29	Out of print	New rept. being prepared
Kings	Oct. '30	.40	
Lake	Jan. '47	.75	
Lassen	Oct. '36	.60	
Los Angeles	July '37	.60	
Madera	Oct. '28	.30	New rept. being prepared
Marin	July '26	.30	
Mariposa	Apr. '28	Out of print	
Mendocino	Oct. '29	.30	
Merced	A pr. '25	Out of print	
Modoc	Oct. '36	.60	
Mono	Apr. '40	.60	
Monterey	Jan. '25	.30	
Napa	Apr. '48	.75	
Nevada	July '41	.60	
Orange	Jan. '25	.30	
Placer (gold only)	Jan. '36	.60	
Plumas	Apr. '37	.60	
Riverside	July '45	.60	
Sacramento	Jan. '25	.30	
San Benito	Jan. '47	.75	
San Bernardino	Oct. '43	Out of print	New rept. being prepared
San Diego	Jan. '39	.60	
San Francisco	Apr. '29	Out of print	
San Joaquin	Apr. '25	Out of print	
San Luis Obispo	Oct. '35	.60	
San Mateo	Apr. '29	Out of print	
Santa Barbara	Oct. '25	Out of print	
Santa Clara	Jan. '30	.40	
Santa Cruz	Jan. '43	.60	
Shasta	Apr. '39	.60	
Sierra	Jan. '42	.60	
Siskiyou	Oct. '47	.75	
Solano	Apr. '27	.30	
Sonoma	July '26	.30	
Stanislaus	Apr. '47	.75	
Sutter	1920*	2.50	
Tehama	July '46	.60	
Trinity	Jan. '41	.60	

LIST OF LATEST COMPLETE DIVISION OF MINES REPORTS ON CALIFORNIA COUNTIES

County	Report	Price	Remarks
Tulare	Oct. '30	$ .40	
Tuolumne	Jan. '28	.40	New rept. in press
Ventura	July-Oct. '32	Out of print	
Yolo	1920*	2.50	
Yuba	July '30	Out of print	

*Report XVII for 1920 contains a short report on every county in the State - Price $2.50 plus tax.

SELECTED REFERENCES TO PUBLICATIONS ON QUICKSILVER IN CALIFORNIA

Type of Reference	Availability		
	State Div. Mines	Federal Supt. of Documents	Out of print
Detailed Geologic Reports:			
Averitt, Paul, Quicksilver deposits of the Knoxville district, Napa, Yolo, and Lake Counties, California: California Div. Mines Rept. 41, pp. 65-89, 1945.	X		
Bailey, E. H., and Swinney, C. M., Walibu quicksilver mine, Kern County, California: California Div. Mines Rept. 43, pp. 9-14, 1947.	X		
Eckel, E. B., and Myers, W. B., Quicksilver deposits of the New Idria district, San Benito and Fresno Counties, California: California Div. Mines Rept. 42, pp. 81-124, 1946.	X		
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State-wide Reports:			
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Forstner, Wm., The Quicksilver resources of California: California Div. Mines, Bull. 27, 260 pp., 1903.			X
Bradley, Walter W., Quicksilver resources of California: California Div. Mines Bull. 78, 389 pp., 1918.			X
Ransome, A. L., and Kellogg, J. L., The quicksilver resources of California: California Div. Mines Rept. 35, pp. 353-486, 1939.		X	
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Statistical Reports:			
Dolbear, S. H., Economic resources and production of California: California Div. Mines Bull. 130, pp. 191-196, 1945.	X		

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Type of Reference	Availability		
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MINERAL RESOURCES OF COLORADO

A thorough and comprehensive report covering the mineral resources of the State of Colorado has recently been published by the Colorado Mineral Resources Board in conjunction with the Colorado Mining Association. The U. S. Geological Survey and the U. S. Bureau of Mines have cooperated in producing this work.

Part 1, by J. W. Vanderwilt, is a descriptive and statistical summary of metals, nonmetals, and fuels arranged by both county and commodity. Part 2, by W. S. Burbank and other staff members of the U. S. Geological Survey, summarizes the geology of the mining districts and individual deposits of the state. Part 3, by W. M. Traver, Jr., summarizes the wartime investigations for strategic minerals by the U. S. Bureau of Mines for the State of Colorado. Copies of this book may be obtained from the Colorado Mining Associa-

PETROLEUM

Crude petroleum produced in California during 1947 amounted to a total of 336,663,293 barrels valued at $551,604,780 at the well, as compared with 317,116,874 barrels worth $386,812,146 for 1946. The 1947 output of petroleum was the largest as to quantity and value for any year so far reported in this state. The quantity totals are compiled from monthly reports filed by the operator with the State Oil and Gas Supervisor.

Prices paid for crude oil in 1947 were increased on March 19 from 20¢ to 25¢ per barrel and on July 1 an additional 20¢ per barrel was granted; again on October 28 a 10¢ increase on all grades was granted; on December 1 one oil company granted a 40¢ per barrel raise; and on Dec. 27 the other oil companies followed with a 50¢ per barrel raise on all grades.

County	1946		1947	
	bbl.	value	bbl.	value
Fresno	42,645,954	$53,357,732	44,604,835	$72,740,057
Kern	100,640,406	120,353,402	107,182,637	170,164,006
Kings	8,265,449	11,984,901	7,583,081	14,938,669
Los Angeles	87,150,496	106,266,566	92,870,934	158,356,425
Orange	31,859,905	38,428,250	34,510,765	56,226,467
Santa Barbara	22,112,577	23,958,353	22,703,321	32,053,742
Ventura	24,391,381	32,416,978	27,145,021	47,037,301
Other Counties	50,706 a/	45,964	62,699 b/	88,113
Totals	317,116,874	$386,812,146	336,663,293	$551,604,780

a/ Includes San Luis Obispo and Santa Clara Counties.

b/ Includes Monterey, San Bernardino, San Luis Obispo and Santa Clara Counties.

All counties showed an increase in the total value of crude oil produced and all but Kings County showed an increase in the number of barrels produced for the year as compared with 1946. The average price received by the producer for crude oil during 1947 in California was $1.64 per barrel.

Olaf P. Jenkins, Chief
State Division of Mines
Ferry Building
San Francisco 11, California

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For other prices see "Revised List of Available Publications, July 1947." This list supersedes all other price schedules.

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MINERAL INFORMATION SERVICE

Vol. 1 August 1, 1948 No. 8

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

COLLECTION AND PUBLICATION OF CALIFORNIA MINERAL STATISTICS

A cooperative agreement has been arranged between the State Division of Mines and the U. S. Bureau of Mines for the collection, processing, and publication of statistics on mineral production in California. The compilation of data on mineral production will be made available as each commodity or group of commodities is completed, and also by county, through the "Mineral Information Service" and later, when completely assembled, will be published in bulletin form by the State Division of Mines. It will also appear in various publications of the Federal Bureau of Mines.

As soon as possible after each December 1, a numbered list of producers will be prepared by the Federal Bureau and additions will be made by the State Division of Mines. To this list of firms statistical inquiries will be mailed by the Federal Bureau, which will also compile the returns from such inquiries. The State will publish by county and commodity totals only; confidential individual figures will be processed by the Federal Bureau; and figures representing the output of less than three producers will not be disclosed unless the Federal Bureau of Mines has obtained written permission to do so from the producers concerned.

NEW PUBLICATIONS ON CHROMITE IN CALIFORNIA

Two new advance chapters of Bulletin 134 entitled "Geological Investigations of Chromite in California" have just been issued in pamphlet form by the State Division of Mines as Chapters 1 and 2 of Part III. Chapter 1 covers Tuolumne and Mariposa Counties, and Chapter 2 covers Calaveras and Amador Counties. The author, Fred W. Cater, Jr., is geologist for the U. S. Geological Survey and the reports are results of strategic mineral investigations carried on during the war period. These reports contain maps showing the distribution of chromite ore bodies and the serpentine rocks in which they occur. History, description, and maps of properties in each district are given. It is stated that Tuolumne and Mariposa Counties have yielded over 6200 long tons of chromite and Calaveras and Amador over 7000.

The entire bulletin, when all parts are completed, will be bound together to form a sizeable bulletin covering chromite throughout the entire state. Parts I and II published previously cover deposits in the Klamath Mountains and Coast Ranges. Part III covers the occurrences of the Sierra Nevada. Chapter 3 of Part III covering Fresno County is now in press.

A limited supply of these advance chapters are now on sale but will not be mailed to libraries or subscribers until the final bound volumne is ready for distribution. Pamphlets now available are as follows:

Wells, F. G., and others, Chromite deposits of Del Norte County, California: pt. 1, ch. 1, 76 pp., November 1946. Price $.77.
Dow, D. H. and Thayer, T. P., Chromite deposits of the northern Coast Ranges of California: pt. 2, ch.1, 38 pp., December 1946. Price $.26.
Cater, Fred W., Jr., Chromite deposits of Tuolumne and Mariposa Counties, California: pt. 3, ch. 1, 32 pp., June 1948. Price $.35.
Cater, Fred W., Jr., Chromite deposits of Calaveras and Amador Counties, California: pt. 3, ch. 2, 60 pp., June 1948. Price $.35.

MINERAL IDENTIFICATION

The Division of Mines laboratory provides free identification of rocks and minerals, based on physical, chemical, and optical examination, for residents of California at the San Francisco address only. Quantitative analyses, both chemical and spectrographic, and assays for the metals can be obtained from commercial chemists and assayers specializing in this work. A list of these will be furnished upon request. Send one or two specimens only, each 2 inches or more in least dimension. On receipt of our report on them two more may be sent to us. If your report is delayed, it means that many other persons have sent in samples ahead of yours. Several hundred of these samples are received each month. A letter should accompany samples, attached to outside of package if possible, stating information desired and locality where found.

SEPTEMBER MEETING AMERICAN MINING CONGRESS

The September meeting of the American Mining Congress will be held at the San Francisco Civic Auditorium September 20-23 inclusive. The meet will also include field trips on the 24th and 25th to the Mother Lode, to dredging operations to the west of the Lode, and to the P. G. and E. tunnel through the Sierra. Registration will be held Monday the 20th at the auditorium. The program will be divided into six general sessions of two hours each and four operative-problem sessions of two each. Topics such as stock piling, mechanization, mine and mill operation, new equipment, tunnelling, timbering, and open pit practice will be discussed. Eighty six manufacturers have been assigned 25000 feet of exhibit space. Reservations may be made through the Convention and Tourist Bureau at the San Francisco Civic Auditorium by mail or by phoning the same agency at Market 1-0652. Speakers and their subjects will be announced in the September issue.

SAN DIEGO COUNTY FAIR GEM AND MINERAL EXHIBIT

The gem and mineral exhibit at the San Diego County Fair (June 25-July5) proved to be an outstanding feature of the show, attracting ninety thousand visitors. Over $1400 in premiums were distributed. San Diego County's prominent position as a producer of gemstones in California was featured in many of the exhibits. George Ashley, of Pala, placed first in the San Diego County gem and gem minerals section. A popular part of the exhibit was the lapidary equipment section, which operated throughout the show. An added attraction was the display of $20,000 worth of gold nuggets and lode specimens through the cooperation of the State Division of Mines and Fair Officials.

CHROMITE

Chromite is a heavy black or brownish-black mineral with a sub-metallic luster which resembles magnetite and specular hematite, but is distinguished from them by its brown streak. A common field test is to bruise the specimen with a hammer or pick and to note its streak. Magnetite has a black streak and hematite a red streak. Chromite is always associated with the more basic intrusive rocks such as peridotite, pyroxenite, and dunite or with their alteration products, serpentine and talc. It occurs in pods, lenses, bunches, nodules, and stringers, or banded and disseminated. Most of the deposits are thought to be formed by early segregation of the chromite in the magma. Chromite has a chemical composition of ferrous chromium oxide ($FeO.Cr_2O_3$) with varying amounts of aluminum, calcium, iron, magnesium, and silica, which reduce the grade of ore. It resists weathering and accumulates in placers and beach sands in areas where the ultrabasic rocks outcrop. There are markets for three grades of chromite:

(1) Metallurgical grade calls for ore that contains a minimum of 48 percent Cr_2O_3 with a chromium-to-iron ratio of 3 to 1 or higher, and for hard lumpy material with not more than 15 percent passing through a ½-inch screen. Some fines or concentrates may be used as part of the raw material in the manufacture of low-carbon ferrochrome. Silica is undesirable, and some consumers are reluctant to use an ore whose combined magnesia and alumina content is over 25 percent.

(2) Refractory grade, which consists of ores having a combined Cr_2O_3 and Al_2O_3 content of 57 percent or more. The silica content should not exceed five percent and the material must be in a hard, lumpy form. Standard refractory ores carry about 33 percent Cr_2O_3, 30 percent Al_2O_3, 17 percent MgO and 10 percent iron, with silica as low as 2 percent.

(3) Chemical grade chromite should contain a relatively high percentage of Cr_2O_3. The silica content must be low, but a low chromium-to-iron ratio is not harmful, and the concentrates and fine material are preferred. Although considerable quantities of ores running 48 percent Cr_2O_3 or higher have been used in the chemical industry, the most important chemical ore comes from the Transvaal and carries 44 percent Cr_2O_3, and has a chromium to iron ratio of about 1.6 to 1, 4 percent silica, 15 percent alumina, and 9 percent MgO. The ore is usually in the form of run-of-mine fines with only occasional lumps.

In 1947 about 800,000 short tons of chromite were consumed in the United States. Approximately 60 percent was used in the manufacture of chromium alloys, 35 percent in refractories, and five percent for other purposes. The largest amount of chromite is used to make ferrochromium for the manufacture of stainless steel and chrome-steel alloys. Ferrochromium is manufactured in electric arc furnaces. The addition of even a small amount of chromium to steel results in greater hardness and tensile strength with little loss in ductility. In addition, the hardening can be obtained to a greater depth, which is a great advantage in the manufacture of armor plate and armor-piercing projectiles. The great strength of chrome steels allows reduction of weight of metal used in automobiles, airplanes, and trains. Stainless steels, containing 18 percent chromium and 8 percent nickel are non-corrosive, tough, hard, and strong. Special chrome alloys, such as stellite, using also tungsten, molybdenum, and cobalt, yield hard, high-speed tool steel. Chromium plating has largely replaced nickel plating. It provides a hard bright surface which resists the corrosive action of ammonia, hydrogen sulphide, and nitric acid, and which is not attacked by molten brass, tin, or zinc.

Chromium alloys are used in the manufacture of exhaust valves, gas turbine blades, pump rods, roller bearings, electric heating elements, and cooking utensils. Refractory ores are used to make chrome bricks used in lining steel and copper furnaces and in repairing basic furnace linings. The principal chromium chemicals are sodium bichromate, sodium chromate, potassium bichromate, potassium chromate, and chromic acid. They are widely used for dyeing, tanning, bleaching, pigments, and oxidizing agents.

Chromium is one of our strategic metals, and in normal times practically all the chromite from which it is obtained is imported. Imports of foreign ore in 1947 is estimated at 1,100,000 short tons compared with 757,391 tons during 1946. During the first nine months 24 percent came from South Africa, 23 percent from Russia, 18 percent from the Philippines, 16 percent from Cuba, and 19 percent from other countries including British West Africa, Canada, India, Mozambique, Southern Rhodesia, Turkey, and Yugoslavia. The Cuban and Philippine ore was refractory grade. Metallurgical ore was imported from Russia, Turkey, and Southern Rhodesia. Most of the chemical ore comes from South Africa.

In California, chromite occurs in the serpentine belts of the Coast Ranges, the Klamath Mountains, and in the northern Sierra Nevada. Most of the properties mined during the war were small and were closed down when the Metals Reserve Company purchase-depots for small lots of strategic minerals were closed in 1945. Most of them were mined by hand methods in open pits. The few deposits mined by underground methods required heavy timbering and were costly to operate. The French Hill mine in Del Norte County was the principal producer during the war and has continued in production. It was converted into an open pit operation in 1947 by removing the serpentine overburden from the chromite lenses with water from hydraulic giants.

Most of the chromite mined was hand sorted and shipped without milling. Some ores having a high chromium-to-iron ratio were concentrated to a satisfactory grade. In 1942 the beach sands off the southern coast of Oregon were concentrated by Humphreys Spiral concentrators followed by magnetic separators. The greater part of our domestic reserves, however, can be utilized for metallurgical purposes only by accepting substandard material or by raising the grade with chemical or electrolytic treatment of the ore or concentrates.

The United States Bureau of Mines is studying the characteristics of chrome alloy steels made in their pilot plant at Shasta Dam. They are using electrolytic chromium with sponge iron made from magnetite mined in Shasta County.

Prices quoted in E & MJ Metal and Mineral Markets for June 24, 1948 ranged from $20 for 44 percent Cr_2O_3 with no chromium to iron ratio specified to $42 for Turkish ore having 48 percent Cr_2O_3 and a 3 to 1 ratio. Domestic ore, 48 percent Cr_2O_3, 3 to 1 ratio, was quoted at $39 per ton on cars, nearest shipping point. All quotations were for long tons.

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MICA

The mica minerals are essentially a group of complex aluminum silicates characterized by almost perfect basal cleavage. They are common and widely distributed minerals in sedimentary, igneous and metamorphic rocks. Commercially important sheet mica, however, is associated only with pegmatites. Muscovite, phlogopite, and biotite species are used for their physical properties, while lepidolite and zinnwaldite (lithium) and roscoelite (vanadium) are valuable as sources of lithium and vanadium. Some schists are sufficiently rich in mica to permit recovery of a ground-mica product. This includes sericite, a finely crystalline form of muscovite.

Muscovite, the potassium variety, is the most valuable of the commercial micas and produces the bulk of the sheet mica used in the electrical and allied industries. Occurring in acid pegmatites, it ranges in color from almost colorless to green, brown, and red. The pink variety can be distinguished from lepidolite by the easy fusibility of the latter. Phlogopite, the magnesium variety, is called "amber mica" because of its prevailing color. It is found in basic pegmatites and like muscovite, is an important source of sheet mica. Biotite, the magnesium-iron variety, is distinguished by its dark color, either dark brown or black. Lepidolite, the lithium mica, usually occurs in scaly masses and is commonly distinguished by the pale to deep lilac color. Zinnwaldite is an iron-lithium mica mined in Germany for the lithium content. It approaches biotite in form and is colored dark gray, pale violet, yellow and brown. Roscoelite, the vanadium variety, is a rare mica and occurs as flakes in certain sandstones in Colorado, Utah and Arizona. It has been mined as a vanadium ore.

The vermiculites are a group of hydrated silicates closely related in part to the chlorites but varying widely in composition. They are alteration products of the micas and retain the characteristic basal cleavage. They are not properly classed as true commercial micas. Upon heating, the vermiculites expand and as an exfoliated product, it is used for insulation and light aggregate purposes.

The nearly perfect basal cleavage of the micas permits splitting along the cleavage plane into extremely thin sheets or films which are tough, elastic, and flexible. Light colored micas split more easily than the dark iron-rich species. Inclusions, crystallographic imperfections, intergrowth, twinning, buckling, and such physical characteristics eliminate a large proportion of mica as sheet and strategic quality material. Magnetite and hematite are the common inclusions.

Mica varies in hardness from 2 to 3.5 and in specific gravity from 2.75 to 3.2. It is easily cut by a knife and the preparation of sheet mica for the market is dependent upon the skillful use of such a tool. Mica crystallizes in the monoclinic system, but is pseudohexagonal in habit. Large, perfect crystals are not common, most of them being irregular and ragged in outline.

The terminology used in the classification of mica and its products varies greatly. Generally speaking, as produced from the mine, crystals are called "book" or "block" mica. Commercial mica is designated principally as sheet, punch, and scrap. Sheet mica, also called uncut sheet mica, is relatively flat and free from structural defects and is used to produce certain shapes and forms. Punch and circle mica is uncut mica which will produce prepared material less than 1-½ inch by 2 inches. Scrap mica consists of mine-run material which will not yield uncut sheet mica, trimmings, and other waste mica resulting from shop preparation. Size and quality classifications are based upon domestic and Indian standards. Size specifications are readily recognized but individual interpretations make quality specifications inexact. American quality standards for mica are clear, clear and slightly stained, fair-stained, good-stained, stained, and black-stained or spotted.

Mine-run mica is usually sorted at the mine and the suitable books "cobbed" or cleaned of adhering rock. Cobbed mica is then "rifted" or split into sheets less than 3/16 inch thick and usually about 1/16 inch thick. Such sheets are then trimmed either by hand (thumb trim) or by knife. Shears are used occasionally and in recent years experiments were conducted using a band saw for trimming. Mica may be prepared on the trimming bench as half trim, three-quarter trim or full trim. Preparation of mica is most important. It requires the services of properly trained and experienced personnel in order to obtain the maximum yield of the most valuable product. Scrap mica, including that from the non-pegmatitic sources, is usually processed by grinding, either wet or dry. A considerable amount of fine mica is obtained as a byproduct in the beneficiation of feldspar and clay.

Mica is an important commercial mineral because of its perfect cleavage, low conductivity of heat and electricity, flexibility, transparency, elasticity, luster, and lubricating properties. A large proportion of sheet mica is used as an electrical insulating material in many shapes and forms. Such mica reached an important strategic position during World War II. Dry-ground mica is consumed mainly by the roofing industry and is used to prevent sticking of the rolled material and for the decorative effects. Wet-ground mica is used by the paint manufacturers to give flexibility to the paint film and increased life to the product. In wallpaper manufacturing the glossy, wet-ground mica increases light reflection. These two industries plus the rubber and lubricant manufacturers are the important users of wet-ground mica.

The United States is the world's largest consumer of mica but produces only 13% to 35% of its requirements of sheet mica, largely the punch and circle sizes and less than 5% of its requirements of splittings. Punch and scrap mica production is nearly sufficient to meet normal requirements. India and Brazil are the largest producers of sheet muscovite mica. Most splittings are produced in India where labor costs are low. Canada and Madagascar produce phlogopite mica. Domestic production of sheet and scrap mica in 1945 amounted to 33,529 short tons valued at $1,246,942.00. Ground mica production in 1945, including that derived from feldspar and clay operations, amounted to 48,224 tons valued at $1,990,596.00.

California's recorded production of mica amounts to 26,918 tons during the period 1902-1946. This consisted mainly of ground mica in the form of sericite derived from mica schists. Imperial, Inyo and Mariposa Counties have been the principal producers. The product is used for roofing, foundry facings and imitation "snow".

Prices paid to miners in the North Carolina district for clear sheet mica range from 60¢ per lb. for the 1-½ inch by 2 inch size to $6.00 per lb. for the 6 inch by 8 inch size. Punch mica is quoted at 6¢ to 15¢ per lb. depending upon size and quality. North Carolina wet-ground mica brings $125.00 to $155.00 per ton, and the dry-ground product ranges from $40.00 to $80.00 per ton. Scrap mica demands $30.00 to $35.00 per lb. depending upon quality.

Considerable experimental work has been done to develop a substitute for mica but none has been produced economically or in such quantities as to eliminate mica as an important electrical insulation material. The Germans are reported to have developed a substitute called "glushartgeweve". This consists of several layers of impregnated glass fibre bonded together by a homogeneous mixture of resinol alcohol and very finely divided kaolin. A silicone rubber "silastic" has been developed by the Mellon Institute and is satisfactory for certain applications normally requiring mica.

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MINING AND INDUSTRIAL NEWS NOTES

Unique Portland Cement Operation at Victorville

Utilization of limestone conglomerate for Portland Cement will be attempted for the first time in California and probably in the United States at Victorville in San Bernardino County. Southwest Portland Cement Company has acquired a large body of this type of material near its reserve quarry east of Sidewinder Well. The rock consists of gray to black limestone cobbles in a grayish-white lime matrix. The only foreign material present in any quantity is chert; brown chert pebbles are present in minor quantity throughout most of the formation. Chemical analyses have shown the conglomerate to be satisfactory for use in Portland cement and superior to many of the massive crystalline limestone bodies in the Victorville vicinity. The basic dikes which damage the other limestones of the vicinity for cement use are largely absent in this conglomerate. The deposit is lens shaped and is exposed for slightly over a mile along the strike. The maximum width of the lens is about 3000 feet, and 850 feet of it is exposed above base level. Three typical analyses of the material are as follows:

Sample 1		Sample 2		Sample 3	
SiO_2	8.76	SiO_2	9.48	SiO_2	8.52
Al_2O_3	1.14	Al_2O_3	1.20	Al_2O_3	1.13
Fe_2O_3	0.58	Fe_2O_3	0.58	Fe_2O_3	0.59
CaO	47.40	CaO	48.50	CaO	48.20
MgO	2.56	MgO	1.64	MgO	2.66
Ig. Loss	38.65	Ig. Loss	38.44	Ig. Loss	39.43

The company has built a spur track from the Quartzite Mountain line to Sidewinder Well, a distance of about five miles. This will eventually be extended six miles to the vicinity of the reserve quarry at which point a crusher will be erected. Seventy-ton General Electric diesel-electric locomotives are used to haul six 60-ton capacity side-dump cars. Sixty-ton capacity side-dump diesel trucks haul rip-rap from the quarry to the spur track terminus.

Activity in Shasta Copper Belt

The sustained demand for copper, lead, and zinc has revived interest in the old Shasta Copper Belt near Redding, and a group of distinguished mining geologists are now mapping and making field studies in the area. This district was one of the most important copper districts in America at one time and has a recorded production of almost 700,000,000 pounds of copper. The zinc minerals that are found associated with the copper in some deposits gave trouble in the copper smelters and were left unmined and avoided when possible. The great advances made in the selective flotation processes in recent years have made possible the separation of copper and zinc minerals and the production of a concentrate of each that is acceptable to smelters. The Mountain Copper Company, Ltd. had developed sufficient zinc copper ore in 1943 after almost fifty years of mining copper, pyrite, and gold ores at Iron Mountain to justify the erection of a selective flotation plant having a capacity of 350 tons per day. It was kept in operation for about four years and contributed several million pounds of both copper and zinc to the war effort. The Coronado Copper and Zinc Company, a Harvey Mudd interest, purchased the old Afterthought mine at Ingot near the eastern end of the copper belt in 1945. They have since developed sufficient zinc-copper ore to justify a flotation plant, and one is now being built at the mine. The Shasta Copper belt also includes massive pyrite deposits which are mined and shipped to the San Francisco bay area. It is used in the manufacture of sulphuric acid, and many tons are used each day to treat rock phosphate mined in Idaho and Wyoming to make the fertilizers needed to replenish our soil.

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MINERAL INFORMATION SERVICE

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MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

MINING AND INDUSTRIAL NEWS NOTES

New Humboldt County Copper Operation

The old Horse Mountain Copper Mine on Horse Mountain is being reopened and developed. The property, which includes over fifty claims, has been idle for many years and buildings and equipment are badly deteriorated. A mine mill, sawmill, assay laboratory, and accomodations for 200 men were on the property. The deposits are of replacement type near the contact of hornblende diorite and gabbro intrusions. Copper minerals are mainly chalcocite and malachite with some bornite and native copper. Ore bodies occur as lenses in shear zones in serpentine. The property has been purchased by the G. L. Speier Company of Arcata and Mr. G. K. Griffith of Eureka is supervising the operation.

Inyo County Clay Operation at Keeler

Production of bleaching clay at Keeler has been trebled since 1946. Rail shipments are now made from Keeler but will eventually be made from Olancha, 12 miles to the west on the opposite side of Owens Lake. Recent improvements include construction of a new storage bin to facilitate truck haulage, and a new ramp for loading directly onto railroad cars at Olancha is under construction. Clay is mined by room and pillar methods and slushers economically handle the raw material. Processing of clay is done at the Los Angeles plant of the Sierra Talc and Clay Company who also operate the property at Keeler. The finished product is marketed under the name of "Adsorbol" which is used primarily for decolorizing and bleaching animal and vegetable oils. An increased market for the product for decolorizing and bleaching in the sugar beet industry is developing.

Clay in Placer County

Production of fire clays at Lincoln has almost doubled since 1947. Much of the clay is processed and manufactured into refractory and non-refractory products locally, but considerable clay is shipped to consumers in other counties after being crushed. Gladding-McBean & Company and Lincoln Clay Products Company are the principal producers.

Gold Operations Near Washington, Nevada County

Long range development work is being carried on at the Ancho Erie mine between Graniteville and Washington. Ore bodies there are lengthening and broadening with depth and the outlook is very favorable toward operations on a greatly increased scale. Ore will be milled during 1948 mainly from development work, and major production is not expected before 1949. The mill has been increased to process between

200 and 300 tons a day but it will not be run at capacity until much of the development work is completed. The wall rocks are slate, phyllite, and schist of probable Paleozoic age and the vein presently being worked strikes N 50° W and dips steeply eastward at angles greater than 75°. Gold is associated with galena, and pyrite is largely barren. The gangue is principally quartz. Flow sheet of the mill is similar to those of Grass Valley. Operations are in charge of Fred Anderson of Grass Valley. About 30 men are employed.

The Gaston mine adjoining the Ancho Erie on the northeast is also operating on a limited scale. The ore bodies lie on a quartz diorite-slate contact but have been much brecciated by post-mineral faulting so that the gold lies largely in a black gouge of slate and quartz fragments. Mining is being carried on by shrinkage stoping from the 1100-foot adit. The operation is in charge of Mr. Telford Oates and 9 men are employed.

The Red Cross mine east of Washington has been re-opened for sampling and development work. Mill tests on several lots of ore are currently in process. Mr. Benson of the Spanish Mine is in charge of operations.

NEW PUBLICATIONS OF THE DIVISION OF MINES

Bulletin 139, "California Mineral Production for 1946" by C. V. Averill, C. R. King, Henry H. Symons and F. F. Davis is now being distributed. There are 172 pages of text and four pages of illustrations. The text includes chapters on fuels, metals, industrial non-metallic materials and salines; as well as an appendix listing the minerals produced by counties, a directory of producers, and the smelters, custom mills, quicksilver buyers and mineral brokers, and commercial assay and testing laboratories in California. In value of mineral production, California is exceeded only by Texas and Pennsylvania; but in different kinds of minerals produced California far exceeds other states. The great demand for the materials used in construction caused by the accelerated shift to California of both population and industry has boosted California mineral output from $473,661,591 in 1945 to $559,449,496 in 1946. This increase resulted from higher prices paid for petroleum and natural gas, and an increased output (owing to an unprecedented demand) for salines, structural materials, and certain industrial minerals.

Vol. 44, no. 3, the July issue of the California Journal of Mines and Geology is now being distributed. It includes "Quicksilver Deposits of the Guerneville District, Sonoma County, California", pp. 253-277, 5 figs., and 8 plates, which is a paper on one of the strategic minerals investigated during the last war by the United States Geological Survey geologists W. Bradley Myers and Donald L. Everhart. It discusses the geology, ore deposits, mines and prospects, and reserves and outlook of the Guerneville area. "Unusual Concretions from Templeton, San Luis Obispo County, California" pp. 249-252, 4 illus., by R. A. Crippen, deals with the geological and chemical problems involved in the formation of these concretions. William E. Colby's paper on "Mining Law in Recent Years", pp. 279-292, is a review of recent laws passed dealing with mines and mining activities as well as the historical background responsible for them. "Pumice and Perlite as Industrial Materials in California" pp. 293-318, by C. R. King, tells of their industrial uses and occurrence, processing, the advantages of perlite over pumice, and the cost and selling prices for processed perlite.

Cobalt

Cobalt is a tough steel-gray metallic element similar to nickel. It occurs in igneous rocks as an arsenide or sulphide generally accompanying copper, nickel, silver, lead, and occasionally gold ores. The metal is usually produced as a by-product in the smelting and recovery of these other metals. The chief commercial minerals are smaltite, cobaltite, erythrite and asbolite.

Smaltite $CoAs_2$, or tin-white cobalt, contains 28.1 percent cobalt and variable amounts of iron and nickel. It is generally massive, tin-white to steel-gray in color, and has a metallic luster. The streak is grayish-black, hardness-5.5 to 6, and specific gravity-5.9 to 6.8. Smaltite often has crimson specks and patches of erythrite, or cobalt bloom on its surface. The mineral occurs in veins with other ores of cobalt and nickel or with ores of silver, copper, lead, zinc, arsenic, or bismuth.

Cobaltite, or cobalt glance, CoAsS, a sulfarsenide of cobalt, contains 35.5 percent cobalt. The color is reddish-white, luster-metallic, streak-grayish-black, hardness-5½, and specific gravity-6 to 6.3. Cobaltite often occurs in cubes with striated faces similar to pyrite in veins with other cobalt and nickel minerals.

Erythrite or cobalt bloom, $Co_3As_2O_8 \cdot 8H_2O$, a hydrous cobalt arsenate, occurs as an earthy coating on other cobalt minerals and often draws attention to them. Its color and streak is crimson to gray, hardness-1½ to 2½, and specific gravity-2.95.

Asbolite is a black, earthy, impure mixture of cobalt, manganese, and other metallic oxides.

The most important commercial cobalt-producing localities are: the Katanga district of the Belgian Congo, where it occurs as a cobaltiferous copper ore; Northern Rhodesia, where there is a similar deposit; French Morocco, where smaltite occurs with gold; Ontario, Canada, where cobalt occurs with the silver and nickel deposits; Schneeberg, Germany, where smaltite, linnaeite, and asbolite are associated with silver, bismuth, and uranium. New Caledonia has comparatively large deposits of asbolite and at one time furnished 90 percent of the world's cobalt. Other deposits are found in Burma, New South Wales, South Australia, India, Norway, Sweden, Finland, Chili, Brazil, and Peru. Some cobalt was recovered in the United States as a by-product from the iron mines at Cornwall, Pennsylvania, in 1947, and some raw iron concentrates shipped from a property near Fredericktown, Missouri, contained 2 percent cobalt. In California some of the copper ores of the foothill copper belt in Mariposa and Madera counties contained up to 3 percent cobalt, but no commercial production is recorded.

The peacetime demand for cobalt continued to expand in 1947, and imports were up 330 percent in the first nine months of 1947 over the corresponding period of 1946. They included 1,289 short tons of alloy containing 1,104,974 pounds of cobalt from Belgian Congo; 376 tons of Canadian ore containing 77,721 pounds of cobalt; 4,420,250 pounds (gross weight) of rondelles, fines and granules, chiefly from Belgium and Belgian Congo; 476,350 pounds of oxide containing 338,200 pounds of cobalt from Belgium, and 396 pounds (gross weight) of salts and compounds from the United Kingdom. Most of the cobalt is now produced from cobalt-bearing copper ores found in the Katanga district of Belgian Congo. It is contained in the blast furnace slag, which is reduced in an electric furnace to form a copper-iron-cobalt alloy. Prior to World War II this alloy was refined in Belgium, but it is now shipped to a plant at Niagara Falls, New York, which has a capacity of about 1,300 tons of cobalt per year. The crude alloy has also been refined to cobalt salts and cobalt oxide in Ohio and New Jersey plants. Details of the processes are closely guarded.

The largest amount of cobalt is now used in the manufacture of permanent-magnet alloys, which accounted for 26 percent of the total consumption in the first nine months of 1947. The demand for cast cobalt-chromium-tungsten-type alloys and enamel was much greater than in 1946. Stellite and stellite-type alloys, which contain 45 to 55 percent of cobalt, 30 to 35 percent of chromium, and 12 to 17 percent tungsten are used for high-speed, heavy-duty, high temperature cutting tools, and die materials. Vitallium, an alloy containing about 65 percent cobalt, 30 percent chromium, and 5 percent molybdenum, is used for jet propulsion engines and for turbine buckets of both gas turbines and turbo-superchargers. Other important uses are in valve steel, welding rod, and carbide-type alloys. Smaller quantities are used in the ceramic industry, in the preparation of driers, in electroplating, as a catalytic agent in promoting oxidation reactions, and for a variety of minor uses. Metallic cobalt may be made from the oxide by briquetting it with a carbonaceous material, or passing hydrogen over it. Carbon monoxide also reduces the oxide above 500 degrees Centigrade. Metallic cobalt can be drawn into wire that is stronger than either nickel or iron. It also resists corrosion by salt solutions and alkalies. Its properties are much the same as nickel but it finds few uses because it costs several times as much.

A large percentage of the total cobalt production is used as cobalt oxide (Co_3O_4), which contains about 70 percent cobalt. A mixed hydrated oxide of cobalt and nickel containing small amounts of copper and manganese is used for enamel ground coats, and the difficult process of separating the nickel and cobalt is thereby avoided. Cobalt is separated from nickel by a comparatively expensive wet chemical process. The process is based upon the fact that in neutral solutions cobalt is more readily oxidized than nickel. The oxidized cobaltic compound hydrolyzes and precipitates. It is filtered off leaving nickel in solution. The precipitate is dried and ignited to cobalt oxide. Cobalt oxide is a necessary ingredient in nearly all porcelain enamel ground coats. A small amount effectively promotes the adherence between the enamel and the metal. The brilliant blue in ceramic materials is due to cobalt oxide, and most blue oil paints contain some cobalt.

The normal need for cobalt can be supplied for many years by the principal known deposits, so that the development of minor and noncommercial deposits need not be undertaken in the near future. Relatively little cobalt is exported from the United States. The E & MJ Metal and Mineral Markets, July 15, 1948 quoted cobalt 97 to 99 percent metal at $1.65 per pound in 500 pound lots.

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BULLETIN 129 - IRON RESOURCES OF CALIFORNIA

Bulletin 129 "Iron Resources of California" is now ready for distribution. This bulletin contains 16 individual articles contributed by various authorities on the geology of the iron-ore deposits of the state. Never before has such a complete bulletin been issued covering in detail descriptive matter concerning all of the known iron-ore deposits of importance in California. Previous to World War I production was limited to very small amounts of ore consumed in an early pig-iron industry and, in later years, to somewhat larger tonnages used as ship ballast and in the manufacture of high-iron cements. During World War II, attention was focused on the strategic importance of western iron deposits and two federal agencies of the Department of the Interior, the Geological Survey and Bureau of Mines undertook concurrent, cooperative investigations of California iron resources together with the Division of Mines. The results of these studies form the bulk of this bulletin.

METAL MINING IN CALIFORNIA, 1947 - FINAL ANNUAL FIGURES 1/

California lead production in 1947, continuing the upward trend started in 1944, was 16 percent greater than in 1946 - only 8 percent below the record output of 1917 - and the value was the largest in the history of mining in the State, according to the San Francisco Office of the Bureau of Mines, United States Department of the Interior. The output of silver was up 19 percent largely because of the higher price for the metal and the fact that its production was closely allied to the production of lead in the state. Gold production gained 21 percent principally due to the operation of more gold-producing properties, lode as well as placer. Expiration of the Premium-Price Plan for copper, lead and zinc on June 30, 1947, had an adverse effect on the production of copper and zinc, the output of both metals dropping far below that of 1946. The total value of gold, silver, copper, lead, and zinc recovered in 1947 was $21,704,640 - an increase of 16 percent from $18,788,664 in 1946. The value of lead increased 34 percent, silver 33 percent, gold 21 percent, whereas zinc and copper each decreased 26 percent.

The value of the metal production herein reported has been calculated at the following prices; corresponding prices for 1946 are shown in parenthesis: Gold $35 per fine ounce ($35); silver $0.905 per fine ounce ($0.808); copper, $0.210 per pound ($0.162); lead $0.144 per pound ($0.109); and zinc $0.115 per pound ($0.122). The weighted average prices for base-metals in both years included premium payments made under the Premium-Price Plan.

The principal producers of gold, silver, copper, lead, and zinc in California in 1947 were: Gold, the Natomas Co., Folsom district, Sacramento County; silver and lead, Anaconda Copper Mining Co., Darwin group, Coso district, Inyo County; copper, Pacific Mining Co., Newton Mine, Ione district, Amador County (ceased operation August 31, 1947); and zinc, Shawmut Copper Mining Co., Campo Seco district, Calaveras County (ceased operation October 10, 1947).

Mine production of gold, silver, copper, lead, and zinc in California, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	34,975	186,018	253	969	450
February	34,029	180,475	212	1,078	521
March	32,874	164,042	243	1,395	674
April	42,537	167,640	354	1,286	909
May	40,541	147,123	334	969	797
June	36,025	146,539	303	841	736
July	37,663	92,474	273	613	501
August	34,827	99,475	263	633	317
September	35,017	114,548	111	752	306
October	34,764	83,237	41	505	102
November	34,134	113,770	10	544	77
December	34,029	102,101	10	495	25
Total: 1947	431,415	1,597,442	2,407	10,080	5,415
1946	356,824	1,322,830	4,240	9,923	6,877

1/ Prepared by Alfred L. Ransome, San Francisco Office, under the supervision of Charles White Merrill, Chief, Metal Economics Branch, Economics and Statistics Division. The cooperation of the California Department of Natural Resources, Division of Mines, is acknowledged.

Mine production of gold, silver, copper, lead, and zinc in California, 1947, by counties in terms of recovered metals

County	Mines producing 1/		Gold				Silver			
			Fine ounces		Total		Fine ounces		Total	
	Lode	Placer	Lode	Placer	Fine ounces	Value	Lode	Placer	Fine ounces	Value
Amador	8	11	2,016	2,708	4,724	$165,340	11,223	375	11,598	$10,496
Butte	3	10	157	26,880	27,037	946,295	207	1,994	2,201	1,992
Calaveras	13	11	4,835	336	5,171	180,985	97,040	36	97,076	87,854
Colusa	1	-------	6	-------	6	210	3	-------	3	3
El Dorado	13	12	385	2,609	2,994	104,790	1,644	395	2,039	1,845
Fresno	1	3	5	230	235	8,225	-------	37	37	33
Humboldt	-------	1	-------	139	139	4,865	-------	22	22	20
Inyo	41	-------	1,974	-------	1,974	69,090	1,235,998	-------	1,235,998	1,118,578
Kern	16	6	6,154	74	6,228	217,980	7,671	15	7,686	6,956
Lassen	1	-------	1	-------	1	35	6	-------	6	5
Los Angeles	-------	4	-------	48	48	1,680	-------	6	6	5
Madera	-------	4	-------	197	197	6,895	-------	57	57	52
Mariposa	15	5	5,705	658	6,363	222,705	1,848	85	1,933	1,749
Merced	-------	3	-------	16,422	16,422	574,770	-------	1,505	1,505	1,362
Mono	2	-------	41	-------	41	1,435	7,323	-------	7,323	6,627
Nevada	11	14	76,123	5,207	81,330	2,846,550	24,922	822	25,744	23,298
Placer	4	25	537	4,821	5,358	187,530	254	553	807	730
Plumas	4	7	422	124	546	19,110	551	19	570	516
Riverside	2	1	28	2	30	1,050	15	-------	15	14
Sacramento	-------	14	-------	113,560	113,560	3,974,600	-------	6,203	6,203	5,614
San Bernardino	24	2	2,081	2,328	4,409	154,315	103,477	400	103,877	94,009
San Diego	1	-------	13	-------	13	455	6	-------	6	5
San Francisco	-------	1	-------	4	4	140	-------	-------	-------	-------
San Joaquin and Shasta 2/	6	7	579	17,677	18,256	638,960	76,516	1,911	78,427	70,977
Sierra	12	10	12,821	442	13,263	464,205	2,449	52	2,501	2,263
Siskiyou and Stanislaus 2/	9	24	753	38,388	39,141	1,369,935	172	4,171	4,343	3,931
Trinity	2	20	100	13,805	13,905	486,675	96	1,581	1,677	1,518
Tuolumne	19	5	4,125	107	4,232	148,120	2,005	10	2,015	1,824
Yuba	2	10	16	65,772	65,788	2,302,580	2	3,765	3,767	3,409
Total: 1947	210	210	118,877	312,538	431,415	15,099,525	1,573,428	24,014	1,597,442	1,445,685
1946	150	172	87,052	269,772	356,824	12,488,840	1,322,830	19,821	1,342,651	1,084,862

Mine production by counties, continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Amador	1,674,000	$351,540	-------	-------	-------	-------	$527,376
Butte	-------	-------	-------	-------	-------	-------	948,287
Calaveras	1,242,000	260,820	180,000	$25,920	4,700,000	$540,500	1,096,079
Colusa	-------	-------	-------	-------	-------	-------	213
El Dorado	112,000	23,520	4,000	576	12,000	1,380	132,111
Fresno	-------	-------	-------	-------	-------	-------	8,258
Humboldt	-------	-------	-------	-------	-------	-------	4,385
Inyo	232,000	48,720	17,980,000	2,589,120	1,404,000	161,460	3,986,968
Kern	-------	-------	-------	-------	-------	-------	224,936
Lassen	-------	-------	-------	-------	-------	-------	40
Los Angeles	-------	-------	-------	-------	-------	-------	1,685
Madera	-------	-------	-------	-------	-------	-------	6,947
Mariposa	4,000	840	-------	-------	-------	-------	225,294
Merced	-------	-------	-------	-------	-------	-------	576,132
Mono	18,000	3,780	34,000	4,896	-------	-------	16,738
Nevada	-------	-------	-------	-------	-------	-------	2,869,848
Placer	-------	-------	-------	-------	-------	-------	188,260
Plumas	28,000	5,880	-------	-------	-------	-------	25,506
Riverside	-------	-------	-------	-------	-------	-------	1,064
Sacramento	-------	-------	-------	-------	-------	-------	3,980,214
San Bernardino	92,000	19,320	316,000	45,504	1,300,000	149,500	462,648
San Diego	-------	-------	-------	-------	-------	-------	460
San Francisco	-------	-------	-------	-------	-------	-------	140
San Joaquin and Shasta 2/	1,396,000	293,160	1,634,000	235,296	3,414,000	392,610	1,631,003
Sierra	-------	-------	12,000	1,728	-------	-------	468,196
Siskiyou and Stanislaus 2/	-------	-------	-------	-------	-------	-------	1,373,866
Trinity	4,000	840	-------	-------	-------	-------	489,033
Tuolumne	12,000	2,520	-------	-------	-------	-------	152,464
Yuba	-------	-------	-------	-------	-------	-------	2,305,989
Total: 1947	4,814,000	1,010,940	20,160,000	2,903,040	10,830,000	1,245,450	21,704,640
1946	8,480,000	1,373,760	19,846,000	2,163,214	13,754,000	1,677,988	18,788,664

1/ Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
2/ Combined to avoid disclosure of individual output.

Ore sold or treated in California in 1947, with content in terms of recovered metals

Source	Ore 1/ (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	438,812	111,164	44,272	172,000	16,000	12,000
Dry and siliceous gold-silver ore	3,053	1,315	48,738	900	2,700	-------
Dry and siliceous silver ore	7,927	89	40,241	32,400	595,400	-------
Copper ore	15,993	2/371	2/19,811	2/5/1,888,200	2/2,800	-------
Lead ore	87,913	1,752	1,213,277	165,600	17,611,500	1,315,400
Zinc ore	3/49,651	4/3,665	4/136,144	4/1,307,900	4/233,200	4/5,997,900
Zinc-copper-ore	35,745	138	21,863	1,053,700	28,000	1,038,000
Zinc-lead ore	9,695	383	49,082	193,300	1,670,400	2,466,700
Total lode mines: 1947	3/648,789	2/4/118,877	2/4/1,573,428	2/4/5/4,814,000	2/4/20,160,000	4/10,830,000
1946	3/627,767	2/4/87,052	2/4/1,322,830	2/4/8,480,000	19,846,000	13,754,000

1/ Includes 20,565 tons of old tailings in 1947, and 73,203 tons in 1946.
2/ Includes metal recovered from pyritic ore (residue).
3/ Excludes tungsten ore.
4/ Includes metal recovered from tungsten ore.
5/ Includes 8,800 pounds from precipitates.

AMERICAN MINING CONGRESS CONVENTION AND EXPOSITION

The annual meeting of the Western Division of the American Mining Congress will be held at the San Francisco Civic Auditorium, September 20-23 inclusive. This will be the 50th anniversary of the organization as well as the 100th anniversary of the discovery of gold in California. In addition to the four days of meetings and exhibits there will be five different field trips beginning on Friday the 24th, 3 of 2 days each and 2 of 1 day each. An extensive program and exhibition covering all phases of the metallic and non-metallic mining industries has been arranged. For further particulars write or phone the Convention and Tourist Bureau at the San Francisco Civic Auditorium, phone Market 1-0652.

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Vol. 1 October 1, 1948 No. 10

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

COMMODITY STATISTICS FOR 1947

Quicksilver

Quicksilver produced in California during 1947 came from 25 properties in 8 counties and amounted to 17112 flasks weighing 76 pounds each worth $1,386,087 f.o.b. mine as compared with a 1946 production of 17804 flasks worth $1,647,758 which came from 34 properties in 12 counties.

The largest producer was the New Idria mine in San Benito County followed by the Mt. Jackson mine in Sonoma County, the Reed mine in Yolo County, and the Buena Vista mine in San Luis Obispo County. These four mines accounted for 90% of the 1947 quicksilver production. California, as in the past, leads all states of the United States in production of quicksilver accounting for 75% of the nation's output.

The average value of quicksilver for the year 1947 was $83.74 per flask of 76 lbs., New York quotation compared with $98.24 per flask in 1946 and $134.89 per flask in 1945. The California producer received an average of $81.00 per flask in 1947 as compared with $92.61 per flask in 1946, and $128.08 per flask in 1945. At the end of 1947 only two properties of any size were in operation, namely the New Idria and Mt. Jackson. All others were shut down owing to the low price to which the metal had fallen and the high cost of labor and supplies. On January 1, 1948, the New York quotation on quicksilver was $79.00 per flask, the lowest price offered for that commodity since 1939. Present quotations at New York are from one to three dollars lower than the January 1 quotation.

MINING AND INDUSTRIAL NEWS NOTES

Pumice Mining Operation in Siskiyou County

Pumice is being produced in considerable tonnage from the northwest end of Glass Mountain on the Medicine Lake Highland of Siskiyou County. The Thompson Pumice Company deposit ranges in depth from 6 to 40 feet, average depth at the quarry being 12 feet. The pumice is grayish-white and is stronger than average natural pumice. It occurs in particles which range in size from ¼ inch to 8 inches, fragments being loosely packed in the deposit. Reserves are estimated at 17,500,000 cubic yards on the 880 acres controlled by the Thompson interests. The 1947 output was 17,500 yards and estimated production for 1948 is 30,000 yards. Current production is at a rate of 2500 yards per month. Material is shipped to Oregon and Nevada and as far south in California as Modesto and San Jose. The bulk of the output is marketed in the San Francisco Bay area. The pumice is utilized for pre-cast reinforced concrete, building blocks, soil conditioners, and dry wall insulation. The rock is mined in open pits and loaded into 8 yard capacity trucks which haul and stock pile the material alongside a railway loading ramp at the Tionesta station. The operator, Thompson Pumice Company, is owned by Paul D. Thompson of Tionesta.

New Dragline Gold Dredging Operation

A dragline dredge brought from Siskiyou County is being reassembled at Long Bar on the North Fork of the American River, 8½ miles north of Folsom. The gravel deposit at the new site is about 10 feet deep and composed of fine to medium-sized pebbles which are uncemented and free of overburden. A capacity of 50,000 cu. yds. per month is anticipated. Dredging is expected to begin soon with a crew of thirteen men to be employed. The operation as being conducted by the El Dorado Placer Mining Corporation of which Marion G. Henness is president, Walter N. Clark, vice president, and Thomas S. Fitzgerald, secretary and treasurer, all of Georgetown, California.

NEW PUBLICATIONS OF THE DIVISION OF MINES

Iron Resources of California

The iron resources of California have long been recognized as potentially capable of yielding high grade ores in quantities large enough to support a West Coast steel industry. This fact has been brought out in a treatise entitled Iron Resources of California, Bulletin 129, issued by the State Division of Mines. A great deal of interest has been shown in the publication, requests for copies having been received from as far away as Moscow in Soviet Russia. The treatise describes in detail thirteen of the principal iron deposits of the state and references to many other deposits are included. It is shown that there are more than 100 iron deposits in California distributed through 31 of the 58 counties of the state. The bulletin contains 15 parts comprising geological descriptions of the ore deposits and summaries of the iron mining situation in California. It contains more than 300 pages and is profusely illustrated with 25 plates and 68 figures. The treatise was prepared by members of the Federal Geological Survey, Bureau of Mines, members of the State Division of Mines and others. Bulletin 129 is distributed at the offices of the State Division of Mines, Ferry Building, San Francisco 11, California. Price, $2.50, plus 2½% sales tax.

California Mineral Production for 1946

Bulletin 139, bearing the above title, records the value and amount of production of each fuel, metal, nonmetallic material, and saline material for the year 1946 and, in comparative tables, for every year of its production prior to 1946 of which the Division has a record. Considerable revision of previous statistical bulletins has been done and the fuels incorporated into the new volume. Data concerning marketing and utilization of minerals has been added. Mineral production for each county is tabulated by amount and value of each commodity arranged alphabetically by county. A directory of producers, a list of custom mills and grinding plants, and a list of quicksilver buyers, mineral brokers, and commercial assay and testing laboratories are included.

A study of Bulletin 139 reveals that the overall value and amount of mineral production have been increasing steadily in California; this is particularly true of products used in the construction industry. Between 1940 and 1946, stone, sand, and gravel production increased 72% in amount and 127% in value; pumice output increased 211% in amount and 326% in value; and gypsum production increased 96% in amount and 138% in value. Price, 75¢, plus 2½% sales tax.

BERYLLIUM

Beryllium is a silver-white metal with a specific gravity of 1.85 and a hardness between that of glass and quartz. Its melting temperature, 1285°C., makes it the only stable light metal with a high melting point. Commonly reported as being ductile, this property is possessed only by the pure or nearly pure metal. The only recognized ore mineral is beryl, a beryllium aluminum silicate.

Beryl, $Be_3Al_2(SiO_3)_6$ or $3BeO.Al_2O_3.6SiO_2$, crystallizes in the hexagonal system. The crystals are usually prismatic in habit, often striated vertically, with distinct terminations rare. Beryl sometimes occurs in large masses in coarse columnar, granular, or compact form. It has imperfect and indistinct cleavage; a conchoidal to uneven fracture; is brittle and hard, H. 7.5-8; and has a specific gravity of 2.63-2.8 (usual range 2.69-2.70). Beryl is commonly green but occurs in several varieties with colors of emerald-green, yellow, blue, white, and even pale rose-red. The streak is white. Luster is vitreous and sometimes resinous. Emerald, the bright grass- or emerald-green variety of beryl, is the most valuable of all precious stones. Large, flawless specimens are very rare. The green color is due to the presence of small amounts of chromium. Some of the other varieties used as gems are aquamarine, bluish-green; golden beryl or heliodor, yellow; and morganite, rose color. Chrysoberyl, a beryllium aluminum oxide, is not an ore mineral but is used as a gem in either of two varieties, cats-eye or alexandrite.

Beryllium is said to occur in the earth's crust between tin and arsenic in respect to abundance. Many other beryllium minerals are known but none of commercial importance at this time. Beryl when pure contains 13.9% BeO, but the usual range is between 9% and 11% BeO.

No satisfactory blowpipe tests have been developed for beryllium, and the existing chemical methods for analysis are tedious and require some skill in manipulation. A rapid volumetric method is needed, as it would not only prevent misdirected effort as a result of faulty analysis but would be a help to the plant control laboratories. For an analytical method, the reader is directed to the last reference at the end of this article (Siemans Co.).

Beryllium oxide, beryllia, can be extracted from the ore by treatment with sulphuric acid. Normally beryl is not susceptible to any acid but hydroflouric. However, a 76% extraction of BeO from raw powdered beryl can be obtained by treatment at 265°C. with dilute sulphuric acid. As this temperature is above the boiling point of the acid, high pressures result. If the beryl is given a preliminary heat treatment, its susceptibility to the acid is increased. If it is melted and then quenched in water, it becomes very reactive with strong sulphuric acid at atmospheric pressure. The soluble sulphates from the acid treatment are processed by evaporation and crystallization. The aluminum is crystallized and separated as ammonium alum by using an excess of ammonium sulphate in the strong beryllium sulphate liquor. The beryllium sulphate finally recovered is calcined to beryllium oxide in a rotary kiln at 1450°C.

Beryllia (BeO), which has a high melting point, 2570°C. finds use in ceramics and refractories, which when suitably prepared have a good resistance to thermal shock and show excellent electrical insulating qualities at high temperatures. Beryllia or zinc beryllium silicate is also used as a phosphor in florescent lights.

Beryllium may be produced in alloy form by reduction of beryllia with carbon or hydrogen, or unalloyed by electrolysis of the anhydrous fluoride or chloride salts.

The major use of the metal has been for windows in x-ray tubes where its special value is in permitting the passage of "soft" or long wave length radiations. Minor amounts of the metal are used in nuclear physics. In 1930-32, the study of the radiation product from the bombardment of beryllium by an alpha particle from polonium (a radium product) led to the discovery of a new fundamental physical particle, the neutron. No natural neutron supply exists, and of several reactions that provide neutrons, the one most commonly used is that of radium and beryllium. This was used in the first self-sustaining nuclear reaction pile.

The largest commercial outlet for beryllium is in the various alloys of copper. Beryllium develops properties in copper analogous to those which carbon imparts to steel. The important technologic advantage of beryllium copper is that rapid quenching from high temperatures leaves it in a soft workable state where it can be finished by machining, stamping, or drawing. Hardening for final physical properties is brought about by prolonged "soaking" at relatively low temperatures.

Beryl is obtained from pegmatite dikes in granitic rocks, in which it seldom constitutes more than 1% of the total. It is distributed sparsely and erratically, making mining expensive and difficult and estimation of reserves difficult. Thus it usually cannot be mined for its own sake, but is produced along with mica and feldspar. Since beryl weathers and alters as do the feldspars, it is not concentrated in placer deposits.

The principal occurrences of beryl in California are in the Coahuila and Hemet districts of Riverside County and the Pala district in San Diego County. Domestic production, which was only 95 tons in 1946, came from South Dakota and New Hampshire. The production for 1947 was estimated to be no greater than this. Consumption in 1947 amounted to about 4000 tons, of which nearly 3000 tons were obtained from the Metals Reserve Company during the first ten months. Imports during the same period totaled 712 tons, most of which came from Brazil.

The current (August 1948) price is $20 - $24 per short ton unit of BeO at 10% to 12%. The master beryllium copper alloy, 4% beryllium and the remainder copper, sells for $20.50 per pound of contained beryllium.

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MOLYBDENUM

Molybdenum is a soft, silvery white metal, atomic weight 96, specific gravity 10.2 and melting point 2620°C. (compared to 1773.5°C. for platinum). It has not been found free in the natural state and in its compounds is relatively scarce, being only about as plentiful as antimony, tin, and mercury. It is a comparatively poor conductor of electricity but has high tensile strength, toughness, and resistance to shock. When annealed it can be drawn, hammered and machined. Because of the desirable properties it gives to steel and the saving in weight from its use, over 95% of it used in this country goes into special steels. It is, therefore, of tremendous value in wartime and was under government control as one of the 23 metals and minerals of prime importance. In spite of its relatively poor electric conductivity, its other properties (notably low coefficient of expansion, and the fact it can be welded to glass) have resulted in its use in practically all electric lamps. It is also used for radio tubes and radar equipment as well as for other electrical purposes.

The principal ore is molybdenite, MoS_2, a bluish lead-gray mineral with hardness 1-1.5, specific gravity 4.7-4.8. It is a primary accessory mineral in some granite, granodiorite, pegmatites, and aplites and also occurs in quartz veins associated with such rocks, both shallow and deep-seated. The crystal form (hexagonal) varies, but in deep seated veins or pegmatite it is at lower temperature and pressure, the scales or crystals are smaller. It may occur with tin, tungsten, iron, gold or copper. In the field it may be distinguished from graphite or specular hematite by the greenish-gray streak on white paper; also by the sulfur odor before the blowpipe. Its softness (scratched by the finger nail) and usually less distinct crystal form distinguish it from galena, which is isometric (cubic crystals common) and harder. Wulfenite, lead molybdate, $PbMoO_4$, is a secondary mineral found in the zone of oxidation in lead ores. It has been a minor ore of molybdenum in some mining districts. Ferrimolybdite, hydrous iron molybdate, $Fe_2O_3.3MoO_3.8H_2O$ is a soft, earthy yellow oxidation product of molybdenite, often with limonite. Powellite, $CaO(Mo,W)O_3$, calcium molybdate with calcium tungstate, occurs in California in the Pine Creek tungsten mine near Bishop, and is also reported from Kern and Tulare Counties.

The United States has recently produced most of the world's molybdenum, and is estimated to have a supply sufficient for several hundred years. Ore that would be of commercial grade under conditions similar to those of 1943 is estimated to contain 2,600,000,000 pounds of molybdenum. Marginal and sub-marginal ores are believed to carry 4,400,000,000 pounds more.

The great deposit at Climax, Colorado is the largest source of molybdenite. The ore averages about 0.5% MoS_2. Other important deposits are near Empire, Colorado and Questa, New Mexico. All of the important sources are in the western states except one. Six of 10 mines producing in 1945 yielded molybdenite as a by-product of copper ore. The only recent producer in California, the Pine Creek mine of U. S. Vanadium Corporation near Bishop, Inyo County, produces molybdenum concentrate containing molybdenite and powellite from ore worked primarily for tungsten. U. S. peak production, in 1943, was 61,667,000 pounds of molybdenum, and in 1945 the output was 30,802,000 pounds. The country is more advantageously situated as regards supplies of this metal than of most others.

Although California contains many prospects of molybdenite in areas occupied by granite, none except the one producer named has much development or made much production.

Molybdenite is among the easiest minerals to recover by the flotation process. The usual reagents are kerosene, distillate or light fuel oils with a frother such as American Cyanamide Co.'s Frother 52 or 60. Selective flotation from copper sulfides is said to be possible with Frother 52 without a collector. At the Climax plant a pale neutral de-waxed distillate from paraffin base oil has been used as a collector.

Molybdenum is marketed as ferromolybdenum, calcium molybdate, molybdenum oxide (including trioxide and molybdic acid), metallic molybdenum, and molybdates of ammonium and sodium. The current price of the metal is $2.60 to $3.00 a pound, and of the ore, 45¢ per pound of contained MoS_2 in 90% concentrate.

The great importance of molybdenum during the last war was due to the fact that it could be used with or in place of manganese, tungsten, chromite, nickel, and vanadium, in making alloy steels, when those metals were in short supply. It was used especially in aircraft, in armor plate and armor-piercing shells, in radar and in the machine tool industry. In the last named, it permitted a 50% reduction in use of tungsten.

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ALL-DIVISION FALL MEETING OF THE SOUTHERN CALIFORNIA SECTION OF THE AIME

A two day series of meetings embracing the several divisions of the Southern California Section of the A.I.M.E. will be held at the Los Angeles Elks Club and Biltmore Hotel, October 14-15, 1948. Topics and speakers are of such a stature as to attract intersectional interest in the meet. Technical sessions of the PETROLEUM DIVISION will be held in the Grand Lodge Room of the Elks Club, morning and afternoon on both October 14 and 15. Eight discussions of current technical subjects pertaining to the oil industry will be carried out by members of the technical staffs of the various oil companies, and a moving picture, "Arabian Venture", will be presented by the Standard Oil Company at the final session. The MINING AND MILLING DIVISION will present two technical sessions on October 14, one at 9:00 AM and one at 1:45 PM, both in the El Venado Room of the Elks Club. Discussions will include such topics as smelting of secondary metals, aerial and geophysical approaches to exploration, and geology of various ore deposits. The INSTITUTE OF METALS (Iron and Steel-Metals Group) will present two sessions, both on October 14, one at 2:00 PM and one at 8:00 PM. Both will be held in Conference Room 2 of the Biltmore Hotel. Four discussions on metallurgical subjects and one general discussion are scheduled. The INDUSTRIAL MINERALS DIVISION meetings are on October 15 in the El Venado Room of the Elks Club. The morning session is at 9:00 AM and the afternoon session at 2:00 PM. Nine different non-metallic topics will be discussed such as "Roofing Granules in the Southwest", "California Perlite", and "Some Perlite Deposits in California". A list of speakers and subjects and additional pertinent information may be secured by writingg Mr. L. W. Chasteen, Secretary of the Southern California Section, at 617 West Seventh Street, Los Angeles 14, California, or by telephoning Tucker 7211.

REFERENCE LIST OF RECENT PUBLICATIONS

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MINERAL PRODUCTION OF CALIFORNIA IN 1946-47*
(Certain 1947 figures are preliminary)

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value
Aluminum----short tons--	—	—	—	—
Andalusite----do----	—	—	—	—
Antimony concentrates----do----	—	—	—	—
Arsenious oxide----do----	(1)	(1)	(1)	(1)
Asbestos----do----	(2)	(2)	(2)	(2)
Asphalt (native)----do----	(2)	(2)	(2)	(2)
Barite----do----	(2)	(2)	(2)	(2)
Boron minerals----do----	430,689	$9,575,866	501,935	$11,844,108
Bromine----pounds---	(2)	(2)	(2)	(2)
Calcite (Iceland spar)----do----	(3)	(3)	(3)	(3)
Calcium chloride----short tons-	9,979	170,994	7,968	111,950
Cement----barrels---	20,173,231	33,906,675	22,846,458	46,536,749
Chromite----short tons-	(2)	(2)	948	(2)
Clay:				
Products, heavy clay (other than pottery and refractories)----	—	4/12,175,000	—	4/14,600,000
Raw----short tons-	5/1,670,305	5/2,254,164	5/1,950,076	5/2,965,360
Coke----do----	260,470	(2/ 6/)	332,244	(2/ 6/)
Copper----pounds---	8,480,000	1,373,760	4,814,000	1,010,940
Diatomite----short tons-	(2)	(2)	(2)	(2)
Feldspar (crude)----long tons-	—	—	(2)	(2)
Ferro-alloys----short tons-	7,414	(2/ 6/)	(2/ 6/)	(2/ 6/)
Fluorspar----do----	—	—	—	—
Fuller's earth----do----	(2)	(2)	(2)	(2)
Gem stones----	—	(3)	—	(3)
Gold----troy ounces-	356,824	12,488,840	431,415	15,099,525
Gypsum (crude)----short tons-	574,345	1,315,699	811,798	1,996,157
Iodine----pounds---	(2)	(2)	(2)	(2)
Iron:				
Ore----long tons-	226,062	(2)	373,574	(2)
Pig----short tons-	344,024	(2/ 6/)	453,376	(2/ 6/)
Kyanite----do----	(2)	(2)	(2)	(2)
Lead----do----	9,923	2,163,214	10,080	2,903,040
Lime----do----	172,623	2,144,712	181,296	2,615,599
Lithium minerals----do----	(2)	(2)	(2)	(2)
Magnesite----do----	(2)	(2)	(2)	(2)
Magnesium----do----	56	21,664	—	—
Magnesium compounds (natural)----pounds---	111,906,000	2,814,979	133,206,000	2,898,880
Manganese ore----short tons-	—	—	—	—
Manganiferous ore----do----	—	—	—	—
Mercury----flasks (76 pounds)-	17,782	1,746,904	17,165	1,437,397
Mica, scrap----short tons-	(2)	(2)	(2)	(2)
Mineral waters----	(3)	(3)	(3)	(3)
Molybdenum----pounds---	(2)	(2)	(2)	(2)
Natural gas----M cubic feet-	487,904,000	143,790,000	540,000,000	159,800,000
Natural gasoline and allied products:				
Nat. gasoline and cycle prods--gallons--	734,227,000	32,085,000	837,313,000	45,812,000
Liquefied petroleum gases----do----	176,311,000	4,933,000	233,546,000	8,174,000

es (crude), etc.:				
Copper—short tons	86,297	(7)	15,993	(7)
Dry and siliceous (Au and Ag)—do	335,657	(7)	449,792	(7)
Lead—do	57,330	(7)	87,913	(7)
Zinc—do	45,043	(7)	49,651	(7)
Zinc-copper—do	99,176	(7)	35,745	(7)
Zinc-lead—do	4,264	(7)	9,695	(7)
Peat—do	8,137	105,242	(2)	(2)
Pebbles for grinding—do	74	927	30	362
Perlite—do	886	4,873	—	—
Petroleum—barrels	314,713,000	387,100,000	333,102,000	571,688,000
Platinum metals (crude)—troy ounces	67	(2)	324	(2)
Potassium salts—short tons	(2)	(2)	(2)	(2)
Pumice—do	89,181	755,570	140,000	940,000
Pyrites—long tons	(2)	(2)	(2)	(2)
Quartz crystal—pounds	—	—	(3)	(3)
Salt (sodium chloride)—short tons	729,092	3,358,060	768,397	3,810,898
Sand and gravel—do	27,220,849	18,396,460	31,387,000	25,339,000
Sand and sandstone (ground)—do	(2)	(2)	92)	(2)
Silica (quartz)—do	(2)	(2)	(2)	(2)
Silver—troy ounces	1,342,651	1,084,862	1,597,442	1,445,685
Slate—	—	(2)	—	(2)
Sodium salts (carbonates and sulfates) (natural)—short tons	(2)	(2)	(2)	(2)
Stone—do	8/8,950,320	8/8,452,083	8/12,757,790	8/13,012,556
Strontium minerals—do	243	3,726	—	—
Sulfuric acid (60° B.) 9/—do	(2/ 6/)	(2/ 6/)	(2/ 6/)	(2/ 6/)
Sulfur ore—long tons	757	11,835	698	9,074
Talc, pyrophyllite and gr. soapstone—short tons	78,170	1,434,978	91,537	1,595,422
Tin (metallic equivalent)—do	—	—	—	—
Tungsten concentrates (60% WO_3 basis) do	1,262	1,117,855	394	548,233
Zinc—do	6,877	1,677,988	5,415	1,245,450
Miscellaneous 10/—	—	25,336,529	—	35,281,630
Total value, eliminating duplications—	—	700,086,000	—	958,219,000

1/ Figure not available.
2/ Value included with "Miscellaneous."
3/ No canvass.
4/ Figures obtained through cooperation with Bureau of the Census.
5/ Sold or used; value of clay used in cement and heavy clay products not included in total value for State.
6/ Value not included in total value for State.
7/ Not valued as ore; value of recoverable metal content included with the metals.
8/ Exclusive of marble, value for which is included with "Miscellaneous."
9/ From lead smelting.
10/ Includes minerals indicated by "(2)" and "(8)" above.

* Prepared by Bureau of Mines, U. S. Department of the Interior.

CLAY SOLD OR USED BY PRODUCERS IN CALIFORNIA IN 1947*

COUNTY	KAOLIN		FIRE CLAY	
	SHORT TONS	VALUE	SHORT TONS	VALUE
ALAMEDA	0	0	(1)	(1)
AMADOR	0	0	198264	$380496
CALAVERAS	0	0	0	0
CONTRA COSTA	0	0	0	0
FRESNO	0	0	0	0
HUMBOLDT	0	0	0	0
INYO	0	0	0	0
KERN	(1)	(1)	0	0
LOS ANGELES	0	0	(1)	(1)
MARIN	0	0	0	0
ORANGE	(1)	(1)	(1)	(1)
PLACER	0	0	(1)	(1)
RIVERSIDE	0	0	(1)	(1)
SACRAMENTO	0	0	(1)	(1)
SAN BENITO	0	0	0	0
SAN BERNARDINO	(1)	(1)	0	0
SAN DIEGO	0	0	0	0
SAN JOAQUIN	0	0	0	0
SAN LUIS OBISPO	0	0	0	0
SANTA BARBARA	0	0	0	0
SANTA CLARA	0	0	(1)	(1)
SANTA CRUZ	0	0	0	0
STANISLAUS	0	0	(1)	(1)
SUTTER	0	0	0	0
VENTURA	0	0	0	0
TOTAL CALIFORNIA	16359	$278489	487081	$1069017

1/ Confidential. Figure included in total for State.

NOTE - In addition to the clay shown above, Fuller's earth was produced in Inyo County - figures are confidential.

* Prepared by the Economics and Statistics Division, Bureau of Mines, U. S. Department of the Interior, in cooperation with the California State Division of Mines.

CLAY SOLD OR USED BY PRODUCERS IN CALIFORNIA IN 1947*

BENTONITE		MISCELLANEOUS CLAY		TOTAL CLAY	
SHORT TONS	VALUE	SHORT TONS	VALUE	SHORT TONS	VALUE
0	0	(1)	(1)	(1)	(1)
0	0	0	0	198264	$380496
0	0	108057	$56211 Est	108057	56211 Est
0	0	(1)	(1)	(1)	(1)
0	0	(1)	(1)	(1)	(1)
0	0	(1)	(1)	(1)	(1)
(1)	(1)	0	0	(1)	(1)
0	0	(1)	(1)	213475	746372
0	0	(1)	(1)	477011	436146
0	0	(1)	(1)	(1)	(1)
0	0	(1)	(1)	(1)	(1)
0	0	0	0	(1)	(1)
0	0	(1)	(1)	283177	488765
0	0	(1)	(1)	30619	43336
(1)	(1)	0	0	(1)	(1)
(1)	(1)	49310	42885	63491	232206
(1)	(1)	(1)	(1)	14533	15005
0	0	23891	21146	23891	21146
0	0	(1)	(1)	(1)	(1)
0	0	(1)	(1)	(1)	(1)
0	0	(1)	(1)	158206	100488
0	0	(1)	(1)	(1)	(1)
0	0	0	0	(1)	(1)
0	0	(1)	(1)	(1)	(1)
0	0	(1)	(1)	(1)	(1)
5328	$55500	1441308	$1562354	1950076	$2965360

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MINERAL INFORMATION SERVICE

Vol. 1 November 1, 1948 No. 11

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MINING AND INDUSTRIAL NEWS NOTES

New Napa County Perlite Operation

Exploitation of perlite deposits on the Holt Ranch near Rutherford in Napa County is now underway. The National Perlite Company of Campbell has recently completed the necessary road construction to the deposits and has established a quarry face from which perlite is now being mined and shipped. An unlimited supply will soon be available. The Rutherford deposit was brought to the attention of the present operators through the Mineral Information Service of the Division of Mines. A complete account of the discovery together with a description of the deposit and a location map were published in the January 1948 issue of Mineral Information Service.

Perlite is now being expanded on a commercial scale in California. Prices of the expanded perlite at plants where it is produced range from 18½ cents to 33-1/3 cents per cubic foot in bags. Plants are located in both the Los Angeles area and the San Francisco area, and the price depends both upon the locality and the amount sold on a particular contract. Several sizes are available: coarse, medium, fine, very fine, and extra fine. The expanded perlite is being used in interior plaster and stucco, and may be mixed with either hardwall plaster or cement.

Lime Mountain Limestone Deposit, San Luis Obispo County

Limestone production for the beet-sugar industry has been greatly increased during the past few years at the Lime Mountain deposit in San Luis Obispo County, 26 miles southwest of the town of San Miguel. The 1947 output was double that of any previous year of operation, and further increases are being made in 1948. The limestone has a high calcium content and is strong and compact. Lump-stone is screened to meet size requirements of the sugar industry and large stock piles of stone of dimensions less than 4 inches are available. The lump-stock is hauled to the railroad at San Miguel by six units consisting of a truck and trailer each capable of carrying 19 tons per load. These operate 10 to 12 hours a day. The quarry is operated by Essential Industries, Inc., P. O. Box 576, Paso Robles, of which H. L. Burmeister is President and L. R. Davis is quarry superintendent.

Gold Mining Activities Near West Point, Calaveras County

The New Champion mine located 2 mi. NW of West Point has recently been renamed the Centennial by the present operating partnership of M. G. O'Hanlon and M. G. O'Hanlon, Jr. This mine has operated almost continuously, on a limited scale, since 1946. It is being developed through a 200 foot inclined shaft and drifts along the strike of the vein. The vein strikes about N 8° to 10° W and dips about 60° W. The main ore shoot has been exposed for a distance of 175 feet. It pitches southward at a moderate angle and is offset on the northern end by a fault of unknown displacement. The vein is composed mainly of pyrite, galena, and free gold in a quartz gangue. Presence of tellurides has been reported from time to time. Both hanging and foot walls are granodiorite. Average gold recovery has been something in excess of $50.00 per ton, that figure representing more than 90% of the assay value. The mill and hoisting equipment have been completely overhauled and considerable new equipment has been added.

Another promising lode mine is the Neversweat located about 2 miles northeast of West Point and operated by H. V. Storrs. Five ore shoots have been explored through a 160-foot, steeply-inclined shaft and numerous drifts. The vein strikes about N. 35° W. and dips about 70° W. Ore shoots pitch about 35° S. The wallrocks are granodiorite. Gold occurs in oxidized pyrite in a quartz gangue. Ore removal has been on a small scale purely in connection with development work, and ore is being stockpiled pending completion of the present development program. Many assays have run in excess of $160.00 per ton.

Development work at the Lockwood Mine, 4 miles northeast of West Point is progressing under the direction of Harry E. Briggs. The shaft has been repaired to a depth of about 150 feet, and the operators are in the process of drifting along the vein which has a general NW-SE trend. The gold is in auriferous pyrite and possible tellurides.

NOTES ON RECENT OIL AND GAS DEVELOPMENTS IN CALIFORNIA

New discoveries of petroleum continue to add to the petroleum reserves of the state, although not at a rate approaching the withdrawal and use of petroleum. Most exciting discovery in years is the new Cuyama field in eastern San Luis Obispo and Santa Barbara Counties which Richfield Oil made in June 1948. However, several other recent discoveries in the brief discussion following, may prove of importance as development takes place. Discussion of the basic geology and oil possibilities of all of these areas, up to 1943, will be found in Geologic Formations and Economic Development of the Oil and Gas Fields of California, Bull. 118, Division of Mines, 1943.

Cuyama Valley, San Luis Obispo - Santa Barbara Counties

Richfield Oil Company's discovery well was completed in June, 1948 for 4,000 B/D of 33°-gravity oil just south of the Cuyama River in northeastern Santa Barbara County in Sections 5 and 8-10N-27W. This region is known as the Russell Area. The Colgrave and Norris areas just north of the river in San Luis Obispo County have developed similar wells in sections 30 and 25-11N-27W, respectively. Production comes from the Vaqueros formation of Lower Miocene age in the Colgrave and Russell areas and from the Upper Miocene Santa Margarita formation in the Norris area. Wells are averaging about 4,000 feet in depth. The most aggressive and intensive drilling campaign in years has been taking place in the Cuyama, with enough success to prove the field is an important, if not a major discovery.

San Ardo, Monterey County

After many years of geological exploration of the oil possibilities of the Salinas Valley, the Texas Company completed its San Ardo discovery well in section 27-22S-10E in 1947. Production is small, the oil is of low gravity (10-12°) and contains little gas. The company has completed eight wells to September, 1948 and numerous shallow core holes. Southeast of the discovery well North American and Jergin's oil companies have drilled some successful small wells, with the oil in that region containing considerably more gas. Union Oil is drilling just south of King City. Importance of the San Ardo discovery is in opening up the entirely new, large area of the Salinas Valley to exploration. The active area is in Monterey and San Luis Obispo Counties extending south from King City to the San Luis Obispo County line. Production at San Ardo is from the Santa Margarita formation.

Petaluma, Sonoma County

Recent production of a small amount of oil from shallow wells in Pliocene sands near Petaluma is apparently proving of no commercial importance. However, it is interesting, since little or no oil has been found in northern California, although there is large production of gas.

Guijarral Hills, Fresno County

Oil and Gas Journal, September 23, 1948, reports a new discovery near Coalinga which may prove of considerable importance. Barnsdall Oil Company well 1 Smith in section 34-20S-16E showed a test of 5,300 B/D 33.6° gravity oil from a "pinch-out sand" in the Leda zone (Oligocene). The well is located down-dip on the Pleasant Valley field structure and topped the Leda sand at 8,658 feet.

Ciervo, San Benito County

Texas Company recently completed its Ashurst NCT One, section 27-16S-11E at a depth of 1,688 feet producing 8 to 12 B/D of 16.3° gravity oil. Top of the Paleocene was encountered at 703 feet and production comes from a sand (Paleocene?) at 1,103-1,185 feet.

Placerita Canyon, Los Angeles County

A new, shallow oil field in western Los Angeles County is being developed just east of State Highway 79 in sections 31- and 6- 4N-15W, less than two miles north of the old Elsmere field. Several wells are pumping up to 50 B/D each of heavy oil from a depth of approximately 500 to 1,000 feet. Field mapping by the Division of Mines (unpublished) shows the structure to be a narrow east-west anticline plunging westward but with no apparent closure to the east. The structure is bounded by the San Gabriel fault on the north. The wells are started in Upper Saugus (Lower Pleistocene) gravels and produce from coarse Pliocene sandstone (Elsmere?). One mile east-southeast of the field the Elsmere formation dips 20°-25° off the underlying Pre-Tertiary granodiorite and gneisses of the basement complex. It is believed most likely that the oil and has been trapped in the coarser lenticular sandstone beds wedging out up-dip toward the east.

CLAY IN CALIFORNIA

The Division of Mines is inaugurating a survey of the ceramic type clays of California. The purposes of the survey are to determine the clay resources of the state, with special reference to highly refractory and white-burning clay, and to bring up to date Bulletin 99, "The Clay Resources and The Ceramic Industry of California", published by the State Mining Bureau in 1928. Basic geologic and mining information will be obtained by work in the producing clay areas. This information will serve as a foundation for study of idle and unexploited deposits. On this project the Division is planning to cooperate with the newly established Department of Ceramic Engineering, in the Division of Mineral Technology, University of California at Berkeley. In this arrangement the field work will be done by Mort D. Turner of the Division staff and the testing of the clays will be under direction of Professor Joseph A. Pask of the University.

RECENT GIFTS TO THE LIBRARY OF THE DIVISION OF MINES

The library of the Division of Mines gratefully acknowledges the gift of some very valuable technical publications from Mssrs. George J. Young and Robert Hawxhurst, Jr. Those supplied by Mr. Young included many U. S. Geol. Survey Bulletins and Water Supply Papers; U. S. Bur. Mines Bulletins; numbers of the A.I.M.E. Petroleum Technology; and various publications of the Canadian government and states of Washington and Nevada. Those received from Mr. Hawxhurst included 40 U. S. Geol. Survey Folios, 13 of which were of California area. Many of these folios and some of the other publications are out of print and very scarce and are a valuable addition to the Division Library.

NEW PUBLICATIONS OF THE DIVISION OF MINES

A limited number of cloth-bound copies of California Journal of Mines and Geology for 1947 (volume 43) are now available at the price of $3.00. This volume, bound in black cloth, with gold lettering, contains the following material:

January 1947 Journal, which includes: Walibu Quicksilver Mine, Kern County, California, by Edgar H. Bailey and C. Melvin Swinney; Mines and Mineral Resources of Lake County, California, by Charles V. Averill; Mines and Mineral Resources of San Benito County, California, by Charles V. Averill; Condenser Installation at the New Idria Quicksilver Mining Company, Idria, California, by Richard A. Crippen Jr.; Information in Regard to Mining Claims on the Public Domain; Mineral Patents.

April 1947 Journal, which includes: Mines and Mineral Resources of Stanislaus County, by Abbott Charles; Vanadium, by W. B. Winston; Fifty Years of Operation by the Mountain Copper Co., Ltd., in Shasta County, California, by William F. Kett.

July 1947 Journal, which includes: Status of Topographic Mapping in the United States; Limestone in California, by Clarence A. Logan.

October 1947 Journal, which includes: Annual Report, Division of Mines, for the Ninety-eighth Fiscal Year, by Olaf P. Jenkins; Mines and Mineral Resources of Siskiyou County, by J. C. O'Brien; Silver, by W. B. Winston; Pumice by W. B. Winston; and index to Volume 43.

Geology of the San Juan Bautista Quadrangle, California

A limited number of cloth-bound copies of Bulletin 133, Geology of the San Juan Bautista Quadrangle, California, by John Eliot Allen, are now available for distribution. (Price $2.25.)

San Juan Bautista is the third in a series of quadrangle maps and reports now being issued by the Division of Mines. This report presents a discussion of the stratigraphy, structure, geomorphology, paleogeography, geologic history, and mineral resources of the quadrangle; also included is a report, Operations of the Granite Rock Company Quarry and Plant at Logan, San Benito County, by Royal E. Fowle.

Bulletin 133 is well illustrated with 8 pages of photographs; 10 text figures; a black and white map of the Sargent oil field showing geology and location of wells drilled therein; a plate of structure sections across the quadrangle; and economic mineral map, scale 1:62500, showing by red overprint on topographic base the mineral deposits within the quadrangle; and a lithograph colored geologic map on topographic base, scale 1:62500, similar to the folio maps once issued by the U. S. Geological Survey. The area covered is east of Monterey Bay, at the junction of Santa Cruz, Santa Clara, San Benito, and Monterey Counties.

"Publications of the California State Division of Mines"

Reprints of the California Journal of Mines and Geology, vol. 44, no. 4, October 1948, which lists all the published material of the Division up to September 1, 1948, are now available for distribution free of charge. In addition to the complete list of publications contained therein, a list of intra-state and out-of-state depository libraries which receive Division of Mines publications is included.

NICKEL

Nickel is a silvery-white, ductile, somewhat magnetic, metallic element. It is harder than iron, resistant to abrasion, and has a high melting point. It is highly resistant to the action of air, water, monoxidizing acids, fused alkalies and salts. It is also remarkably resistant to oxidation at high temperatures. It is used chiefly as an alloy in various types of steel. It gives strength, ductility, and resistance to corrosion to its alloys. It is also used in alloys with copper, brass, and bronze, for plating metals, in alkaline storage batteries, and as a catalyst. The chief ore minerals of nickel are the sulphide, pentlandite, $(Fe, Ni)_9S_8$, and the silicate garnierite, $H_2(Ni,Mg)SiO_4nH_2O$. Millerite (NiS), and niccolite (NiAs), also occur in small amounts. Nickel ores are found in almost every country of Europe, in Africa, India, China, South America, Cuba, and in several localities in the United States. The most important deposits, however, occur in Canada, New Caledonia, Norway, and Finland. The Norway deposits are relatively small but were important during the world wars when all their production went to Germany. The Finnish deposits in north Finland near the Russian border have been taken over by the Russian government. They were developed by the International Nickel Company and are reported to contain about 5 million tons of ore carrying 3 percent nickel and 1 percent copper.

The Sudbury district of Canada produces 80 to 85 percent of the world's requirements and probably will continue to do so for many years because it contains the world's largest known reserve. The ores are closely associated with a pre-Cambrian intrusion of norite micropegmatite rock, which encloses an oval-shaped area of later sedimentary rocks. The longer axis of the oval lies in a northeasterly direction and is about 36 miles long. It is about 16 miles wide. Most of the known nickel deposits are found in the outer or basic edge of the norite. The ore consists mainly of pyrrhotite, usually mixed with a rocky gangue, but it is often massive and close-grained in appearance. Copper is always present in the form of chalcopyrite, frequently in sufficient quantity to be easily distinguishable by the eye. The nickel mineral, however, is so intimately mixed with the pyrrhotite that a chemical analysis is usually required to extablish its presence. The chief nickel mineral is pentlandite containing 36.0 percent nickel, 30.4 percent iron, and 33.6 percent sulphur.

The New Caledonia nickel deposits have been worked since 1875 and they contributed 10 percent of the world's total production until recent years, but the proportion has fallen to 5 percent and may be expected to decline further. The ore is chiefly garnierite. Copper and sulphur are absent, and no precious metals are recovered. The deposits are associated with an ultra-basic rock which has been largely altered to serpentine. The nickel mineral occurs in small veins and as concretions enclosing undecomposed rock masses.

The production of Cuban ores began in 1943 and by 1945 surpassed the production of New Caledonia. Although the Cuban ore contains only 0.8 to 1.5 percent nickel, there is a very large reserve. The nickel is in laterite deposits and is accompanied by 1 to 2 percent of chromium.

Substantial reserves of nickel are found in Brazil, the Celebes, Philippine Islands, and Burma, but they probably will be only a minor source of supply for some years.

In the United States, the Gap mine near Lancaster, Pennsylvania, was the chief domestic source of nickel from 1863 to 1893, but it has since been abandoned. Deposits of nickeliferous pyrrhotite, resembling the Sudbury deposits, occur in Colorado, Virginia, and Nevada. Laterite deposits similar to those in New Caledonia are found in Oregon and North Carolina. In Montana, pyrrhotite, chalcopyrite, and pentlandite are associated with the Stillwater basic igneous complex. In the Sitka mining district of Alaska, pyrrhotite, pentlandite, chalcopyrite, and magnetite occur in norite. In California, pentlandite occurs with pyrrhotite in Ventura and San Diego counties; and garnierite has been found in El Dorado, Imperial, Mariposa, and San Benito counties; but no commercial production has been made to date.

The Canadian sulphide ores are concentrated by flotation and tabling. The concentrates are roasted to remove excess sulphur and then smelted in blast furnaces to form a matte carrying iron, copper, and nickel. The silicate ores of New Caledonia have gypsum or pyrite added to the blast furnace charge to furnish the sulphur necessary to form a matte. A silicious flux is added to the blast furnace matte and it is blown in a bessemer converter to remove the iron and part of the sulphur, leaving a rich matte containing about 80 percent nickel. The matte produced from the Canadian ores contains copper and nickel in the same proportion as present in the raw ore. The bessermerized matte is in part subjected to special smelting processes which separate the copper and nickel sulphides. The nickel sulphides are roasted, smelted to a crude metal and electrolytically refined to the pure metal. Monel metal is a nickel-copper alloy obtained by treating the matte without separating the two metals, but the composition is corrected to give the proper percentage of each.

Nickel is marketed in various forms depending on the use for which it is intended. There are - (1) grains, cubes, rondelles, or powder, reduced from the oxide at low temperature without being fused; (2) nickel shot, nickel deposited in concentric layers from nickel carbonyl gas without being fused; (3) electrolytic cathode sheets; (4) blocks or shot obtained by reducing nickel oxide at temperatures above the melting point of nickel and casting the resulting metal or pouring it into water, without deoxidation; (5) malleable nickel, produced in the same manner as (4) except that it is treated with a deoxidizer before pouring; (6) nickel salts; (7) nickel oxide. Most of the commercial production falls in class (4).

The commercial forms of malleable nickel include hot- and cold-rolled sheets; hot- and cold-drawn rods; cold-rolled strip; seamless and welded tubing; pipe; wire; forgings; castings; and fabricated forms such as screen, filter, wire cloth, and wool. The metal may be machined, welded, forged, or brazed.

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SILVER

Because of its relative scarcity and durability, silver has been used for coins for over 2500 years and was employed as a medium of exchange at a much earlier date. For jewelry and kindred purposes its use was prehistoric. During the late war, it was utilized on a scale unthought of a decade ago. Many of these applications may become permanent. It was listed as a strategic metal in Group II.

The whitest metal known, silver has a hardness of 2½ to 3 and specific gravity 10.5. It is second only to gold in malleability and ductility, and in volume conductivity of heat and electricity is superior to copper.

"Fine silver" of the bullion market is 99.99% pure. It is commonly sold in bars of about 1000 fine ounces, troy, but is also obtainable as rolled sterling sheets (925 parts silver, 75 parts copper), sterling wire, in granulated or powdered form, in brazing alloys and silver solder, and as anode silver for plating and jewelry. Newly mined domestic silver, purchased as bullion by the U. S. mints, brings 90.5¢ per fine troy ounce, but smelters of base ore and concentrates pay a net price that may be only 80% of this, depending on contract and types of product. The price for foreign silver in American markets varies with supply and demand. During the first half of 1948 this price has been steady at 74-5/8¢ a fine troy ounce.

Native silver occurs both in primary and secondary deposits. Primary silver is important in the cobalt-nickel veins of Cobalt, Ontario. Electrum, a native alloy of gold and silver, carrying from 20% to 39% silver, is well known. Practically all lode gold contains substantial amounts of silver, and in California the average silver content of all lode gold sold would be around 12%, so that the by-product silver from such mines has been important, though not recorded prior to 1880.

The following important silver minerals are found in California:

Argentite, Ag_2S, color dark lead-gray to black, streak black; hardness 2-2.5; specific gravity 7.3. It is easily reduced to silver on charcoal by the blowpipe. Argentite is a primary mineral and was an important source of silver on the Comstock Lode, at Tonopah, and in Mexico.

Cerargyrite, AgCl, (hornsilver), color gray, greenish, or brown, and hardness 1-1.5, is waxy and easily cut. It has a sp. gr. of 5.5, melts in a candle flame, and easily yields silver before the blowpipe on charcoal. Cerargyrite, is secondary, being formed by action of chlorides (such as common salt) on sulfiies in the shallow parts of deposits in desert regions. It has been one of the more important silver sources of Inyo, Kern, Mono, and San Bernardino Counties.

Miargyrite, $AgSbS_2$, sulphantimonite of silver, black to steel gray, streak cherry red, hardness 2-2.5, and specific gravity 5.3. It was one of the most important and plentiful sources of silver in the California Rand Silver Mine at Randsburg. It is similar to the other sulphantimonite, pyrargyrite, (Ag_3SbS_3), called dark ruby silver ore, and has been confused with it. Two other sulphantimonites of silver are stephanite (Ag_5SbS_4) and polybasite (Ag_9SbS_6). Both are iron-black, have black streaks, metallic luster, hardness 2-3 and specific gravity 6.2. The more important of these two is stephanite, which was plentiful in mines in Mono County.

Proustite, Ag_3AsS_3, light ruby silver or "true ruby silver", is bright red, semi-transparent and has a brilliant red streak. It is often confused with pyrargyrite and may grade into it but is not as plentiful in California.

Stylotypite, $3(Cu_2Ag_2Fe)S.Sb_2S_3$, was next to miargyrite in importance as a source of silver at California Rand Silver Mine at Randsburg. Embolite, Ag(Br,Cl), has been an important silver ore at Calico, San Bernardino County and at a few other mines in the desert region. The tellurides of gold and silver (hessite, petzite, sylvanite and calaverite) are present in many California lode mines but not in quantity sufficient to be important for silver. Silver-bearing galena, zincblende and copper ores have recently been yielding about 3/4 of the silver produced in the U. S.

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In California, San Bernardino County has been the largest silver producer, with a recorded output from 1880-1946 inclusive of $29,750,959. In the first period, 1881-1891 the mines in the Calico district yielded much silver from cerargyrite and embolite. In 1919, the California Rand Silver Mine was discovered and became soon after the largest single producer of silver in the United States continuing in operation until 1930, with a total output of over $16,000,000 in silver and gold, of which the larger part was silver. Many other districts and mines have added to the production.

Shasta County's silver production since 1880 has amounted to over $12,000,000. This came from gossan deposits over copper ore bodies, from copper and zinc ores worked most actively from 1895 to 1919, and from a small silver mining district where silver occurs with tetrahedrite and galena.

Inyo, Mono, and Kern Counties have been important producers with silver coming from galena and from complex ores carrying copper, lead, zinc, and antimony. Inyo is at present the leading producer in the state. The silver comes from lead ores mined in the Coso district and from a tungsten ore mined near Bishop.

In central California, Nevada County has produced slightly over $4,000,000 worth of silver since 1880 mostly from lode gold ores, exceeding the Plumas production of silver from copper ores. The Mother Lode output has come from gold, copper and zinc ores. Over $1,000,000 in silver has come from 2 silver-gold mines in Napa County, the only important contribution from the Coast Ranges.

Industrial consumption of silver in the United States in 1947 was about 100,000,000 fine ounces, about 2/3 of which was used for sterling ware and silver plating. The amount used in silver nitrate, principally for photography, is twice that before the war. About 10,000,000 ounces a year are used now for electrical contact points in airplanes, automobiles, farm equipment, tractors, etc. Brazing alloys or hard solders made of lead and silver or cadmium and silver are coming into increasing use. Alloys of silver with lead, tin, zinc and thallium are also used in bearings. Equipment made from or plated with silver is used increasingly in the chemical and food industries.

During the war, much silver was used in work on the atomic bomb project. Other highly important uses were in military photography; in silver-cladding of main bearings in airplane engines; in miscellaneous electrical equipment; for medical, dental and laboratory work; and as a substitute for copper, tin, nickel, chromium, and aluminum. Military insignia consumed millions of ounces of silver. Preparations for making sea-water fit for human consumption required many tons of silver salts.

The amount of silver used in this country for coinage has been decreasing steadily in the past few years. In 1947 only 25,552,000 fine ounces was so used.

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EARL WARREN, Governor
DEPARTMENT OF NATURAL RESOURCES
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DIVISION OF MINES
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MINERAL INFORMATION SERVICE

Vol. 1 December 1, 1948 No. 12

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MINING AND INDUSTRIAL NEWS NOTES

New Copper-Lead-Zinc Operations in Siskiyou County

The new selective flotation plant of the Coronado Copper and Zinc Company was put into operation this week. The plant was built to treat the complex ores that have been developed at the old Afterthought mine at Ingot, about 25 miles east of Redding. Such ores were unprofitable to work twenty-five years ago at the time the Afterthought mine was shut down. Methods, machines, and reagents, that have since been developed in the selective flotation process, can now make a satisfactory separation of the zinc, copper, and lead minerals contained in the ore. The plant is designed to treat 100 tons per day.

The Afterthought mine was purchased by the Coronado Copper and Zinc Company in 1945 and substantial deposits of copper-zinc-lead ores were developed under the supervision of Lyttleton Price, manager, and Jack Widauf, mine superintendent. Replacement deposits were found to occur in the shales adjacent to the rhyolite in which the copper ores were sought by former operators.

The Coronado Copper and Zinc Company is one of the Mudd family enterprises. The main office is in the Pacific Mutual Building in Los Angeles. The Ingot operation is in charge of R. K. Matheson, general superintendent; H. R. Herner is mill superintendent; Jack Widauf, mine superintendent; and Bruce Stoddard is mining engineer.

Tungsten Mining in Madera County

Tungsten production has been resumed at the Strawberry mine in Madera County, and the first shipment of scheelite concentrate from the mine under the new management has recently been delivered to the Twining Laboratories, Fresno, for sampling and sale. The mine is in the high mountains 85 miles by road northeast of Madera near Clover Meadow Ranger Station. It made substantial production under former operators.

A new company headed by H. A. Savage, A. R. McGuire, mining engineer, and Al Judson all of Fresno began work on the claims in August, and milling of ore began September 1. Thirty men are employed. The mill has a capacity of 50 tons a day. Owing to the high elevation, over 7000 feet, production probably will be interrupted when winter storms begin.

At present a U. S. Bureau of Mines crew is examining and prospecting claims in the district and is quartered at the Strawberry mine. Mining men in the region are seeking the establishment of a government stockpile for purchase of scheelite and other strategic minerals in or near Fresno and believe this would lead to reopening of many mines and prospects now idle.

NEW PUBLICATIONS OF THE DIVISION OF MINES

October Issue of California Journal of Mines and Geology

The California Journal of Mines and Geology, vol. 44, no. 4, for October 1948, is now ready for distribution.

An outstanding article in this issue is the paper prepared by Dr. John Herman on "The Spectrograph and Polarograph". Dr. Herman recently presented the Division of mines with these two valuable pieces of research equipment, and his article describes in detail their use in rock and mineral determination.

The October Journal also contains "Economic Aspects of Mercury Production in California", by C. R. King, which lists California as the largest producer in the United States, cites mercury as a strategic mineral, and gives methods of assuring a healthy domestic mercury industry. Other articles are "Current and Recent Mining Activities in the Redding District", by J. C. O'Brien, which describes the mining activities in Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Shasta, Siskiyou, Tehama, and Trinity Counties; a list of "Publications of the California State Division of Mines"; the "Public Resources Code"; and the "U. S. Atomic Energy Commission's Program to Stimulate Production of Domestic Uranium".

Single issues of the Journal sell for 75¢ each; yearly subscriptions are $2.50.

Geology of the Tesla Quadrangle, California

Paper-bound copies of Bulletin 140, Geology of the Tesla Quadrangle, California, by Arthur S. Huey, are now ready for distribution.

Tesla is the fourth in the series of quadrangle maps and reports now being issued by the Division of Mines. Three previous reports covered the San Benito, Jamesburg, and San Juan Bautista quadrangles. The report is of particular interest because it not only gives a comprehensive picture of the geography, stratigraphy, and structure of the area, but also describes many typical features of the California Coast Ranges and includes a description of economic mineral resources, such as coal, clay, chromite, glass and foundry sand, gravel, lime rock, magnesite, manganese, and tuff.

Bulletin 140 is well illustrated with 8 pages of photographs and 3 plates, including structure sections across the Tesla Quadrangle, an economic map of the quadrangle showing section lines and water supply tunnel, scale 1:62500, and a colored geologic map of the area, scale 1:62500. The area, east of San Francisco Bay, covers approximately the eastern third of Alameda County and a small part of the adjacent San Joaquin County.

Paper-bound copies sell for $1.50; cloth-bound copies, when available, will sell for $2.25.

NEW PUBLICATION ON CHEMICAL INDUSTRIES OF THE WESTERN UNITED STATES

A special survey and directory of chemicals and chemical plants has recently been issued by the western section of "Chemical Engineering", a McGraw-Hill publication with offices in San Francisco. The directory is the first of its kind for the West and one of but few which is strictly limited to actual producers in the areas covered. The survey was made by Mr. John R. Callaham, editor of Chemical Engineering in San Francisco. A partial resumé of the material contained in the survey appears in the following paragraphs.

Nearly 500 different types of prime chemicals are now being manufactured in the West by 245 firms operating some 300 producing plants.

Most of the West's prime chemical producers, Callaham stated, are located in the three Pacific Coast states, which have 71 percent of the manufacturing units. The two largest production centers are the Los Angeles basin and the San Francisco Bay area. These centers are now running neck-and-neck in number of production workers employed. Other centers of production are the Tacoma-Seattle area; Portland-Vancouver on the Lower Columbia River; Henderson, Nev.; the Great Salt Lake basin in Utah; the southern Idaho-Wyoming border area; Anaconda, Montana; Denver, Colorado; Carlsbad, New Mexico; and the smelter areas of southern Arizona.

Largest tonnage production of any basic chemical made in the West is turned out in sulphuric acid operations: Last year 17 plants accounted for almost 750,000 tons or 7.1 percent of the nation's total. Six plants produced 159,500 tons of liquid chlorine or 11.0 percent of the United States total. These units are located in Denver, Tacoma, Portland, Henderson and the San Francisco Bay area.

Unusual chemicals made in the West include algins from sea weeds, montan wax from lignite coals, saponin from the desert's yucca, magnesium compounds from sea water, pharmaceuticals from beet sugar refinery wastes, alcohol from orange molasses and from sulphite pulp waste liquors, borax and alkalies from saline lakes, fertilizers from serpentine rock, varnish constituents from fossil resins, citrates from lemon wastes, medicinals from human blood and fish scrap, iodines from oil well brines, praseodymium compounds from rare ores, products frum cows' milk and from bleached bones.

Other chemicals are made from petroleum refinery gases, coking operations of steel mills, phosphate rock, salt, soap production, vegetable and animal oils, natural gases, silica sand and quicksilver.

Copies of the complete directory and survey can be obtained for $1.00 each from Chemical Engineering, McGraw-Hill Publishing Co., 68 Post St., San Francisco.

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EAGLE MOUNTAIN MINE OPENS

The Fontana steel plant of the Henry J. Kaiser Company is now handling ore by rail from the huge Eagle Mountain mine which has been in the development stage for a considerable period. It is located 15 miles from Desert Center in Riverside County. Prior to the opening of this mine, ore had been taken from the Vulcan property near Kelso. The Kaiser Company recently completed 52 miles of a railroad to link with the Southern Pacific main line. The private spur required slightly less than a year to build. The total haul from mine to mill is about 112 miles. Present daily shipments amount to 1680 tons which is considerably below capacity. Reserves at Eagle Mountain are estimated by the U. S. Bureau of Mines to be in excess of 28,000,000 tons containing 30% or more of contained iron. This figure is enough to warrant the greatly expanded steel program anticipated by the Kaiser Company. About 110 people are employed in the mining operation including operating personnel of the railroad.

ZINC

Zinc is a white-metallic element with a bluish tinge. It is soft (H-2.0) and has a specific gravity of 6.9-7.2. At ordinary temperatures it is brittle, but when annealed, it becomes ductile and can be drawn into wire or rolled into sheets and does not become brittle again upon cooling. However, when heated about 200° C it is again brittle. Its melting point is 419.4°C. There are no authentic occurrences of native zinc, and its chief ores are sphalerite, smithsonite, hemimorphite (calamine), zincite, franklinite, and willemite.

Sphalerite, ZnS, sometimes called jack or black jack, is yellow, brown, or black in color with a brownish, yellow, or white streak. Its luster is typically resinous but sometimes is adamantine. Although it crystallizes in the isometric system, often in tetrahedrons, it commonly occurs in massive cleavable, coarse to fine, granular and compact aggregates. Some deposits are foliated, fibrous and botryoidal. The cleavage is perfect and fracture conchoidal. Sphalerite is usually brittle, with a hardness of 3.5-4.0 and gravity of 3.9-4.1. It is the most important ore of zinc, containing 67% zinc when pure. Zinc sulphide also crystallizes in the hexagonal system, and as such is called wurtzite.

Smithsonite, $ZnCO_3$, sometimes referred to as dry-bone ore from a honey-combed porous appearance of the ore, is usually white with a gray, green, or brownish tinge, or it can be green blue or brown. Its streak is white and its usual luster is vitreous. The mineral crystallizes in the rhombohedral division of the hexagonal system but rarely occurs well crystallized. It is usually reniform, botryoidal, or stalactitic but occasionally occurs in incrustations and in granular or impalpable masses. The hardness is 5 and gravity 4.30-4.45. Smithsonite is usually a secondary mineral produced by the action of carbonated waters upon sphalerite. When pure it contains 52% zinc.

Hemimorphite (improperly called calamine), $(ZnOH)_2SiO_3$, crystallizes in the orthorhombic system with crystals of tabular or prismatic habit. Crystals are often grouped in sheaf-like aggregates and form drusy surfaces in cavities. Hemimorphite may be stalactitic, mammilary, botryoidal or fibrous; also massive and granular. It is white in color, often with delicate bluish or greenish tinges, or can be yellowish to brown. The luster is vitreous, sometimes adamantine, and the streak is white; the hardness is 4.5-5 and gravity 3.40-3.50. When pure it contains 54.2% zinc.

The term "calamine" is a commercial and technical term applied to the oxidized ores of zinc in general as contrasted to the sulphide ores or blendes. Hence, the name hemimorphite should be applied to the above mineral.

Zincite, ZnO; Franklinite, $(Fe,Zn,Mn)O.(Fe,Mn)_2O_3$; and Willemite, Zn_2SiO_4, are normally minor ore minerals but occur together in a unique deposit at Franklin Furnace and Sterling Hill, New Jersey, and are a source of much zinc there. The Franklin Furnace ore is free of cadmium, an unusual circumstance.

Compounds of zinc, when heated on charcoal in a reducing flame, give a coating which is yellow while hot and white upon cooling. If the coating is moistened with cobalt solution and treated in an oxidizing flame, it becomes green. Hemimorphite after this treatment turns blue. Sphalerite is soluble in hydrochloric acid with the evolution of hydrogen sulphide gas.

There are two methods for the extraction of metallic zinc from its ores. The first and older operation, commonly referred to as the retort process, utilizes carbon to reduce zinc oxide to the metal. The second method, the electrolytic zinc process, is a later development in which roasted zinc ores are leached in dilute sulphuric acid, and the resulting solution is subjected to electrolysis, recovering the zinc.

In both processes, the ores are given a preliminary roasting treatment, normally carried out in circular multiple-hearth furnaces capable of roasting as much as 50 tons of ore per day to complete desulphurization. If the ore is to be sintered prior to further treatment, the desulphurization need not be carried so low in the roasting process and greater roaster capacity results.

The electrolytic process was originally confined to treating the complex lead-silver-zinc ores, but later developments have made it more universally applicable. It is estimated that of the 1947 zinc metal production, approximately 850,000 tons, 35% came from electrolytic plants. The remainder, from the retort process, was divided between the horizontal retort plants, 44%, and the vertical retort plants, 21%. The horizontal retort is gradually being supplanted. It should be noted that the entire domestic production of cadmium is derived from treatment of zinc and lead ores.

Metallic zinc is marketed in six grades in descending order or purity: Special High Grade, High Grade, Intermediate, Brass Special, Selected, and Prime Western. In round figures, the domestic consumption of zinc in 1947 (800,000 tons) was divided as follows:

Galvanizing	44.0%
Die casting	27.5%
Brass	12.5%
Misc. (including zinc oxide)	16.0%

It is interesting to note that although brass is one of the oldest alloys known, the knowledge of metallic zinc did not come about in Europe until the 16th Century. Brass was made by heating copper with zinc carbonate (calamine, as it was called) and charcoal. The copper absorbed the zinc fumes and was "colored" to brass.

The California zinc deposits are of two main types; those of Shasta and Calaveras Counties are associated with copper, while those of Inyo, Los Angeles, Orange, San Bernardino and Tulare Counties are primarily lead-silver-zinc and zinc-silver ores. In 1947 California produced 5415 tons of zinc at a value of $1,245,450 as compared with a national mine production of 624,804 tons of the metal. This was a sharp decrease in California production from 1945 and 1946.

From 10.5 cents per pound for Prime Western grade in November, 1946, after price control, the price has risen to 15 cents, reaching that point on July 28, 1948. At that price the demand for the metal is active and the market is strong.

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AGRICULTURAL MINERALS AND MINERAL FERTILIZERS

Agricultural minerals, as defined by the State Department of Agriculture, are "mineral substances, mixtures of mineral substances, and mixtures of mineral and organic substances which contain less than five percent (5%) of available nitrogen, phosphorus pentoxide (P_2O_5), or potassium oxide (K_2O) singly, collectively, or in combination except soil or sand." Similar substances containing more than 5% of the above available compounds are termed mineral fertilizers. This paper is concerned primarily with natural mineral substances produced and sold in California for the purpose of obtaining greater crop yields from California soils. In general, a chemical compound is considered "available" if it is soluble in distilled water and can be immediately and readily absorbed by plant roots. A third category of soil additives are peat, peat moss, sand, leaf mold, and unrotted plant materials. These are classed under the term "soil,amendments." Those containing organic material have a dual fertilizing value; others, like sand merely add desirable physical characteristics to a soil. The first three are identified with the mining industry and will be considered briefly here.

The only concentrated mineral fertilizer produced in California is potash. Although most California soils are not particularly deficient in potash, most commercial fertilizers are composed of all three of the major fertilizing elements-nitrogen, phosphorus, and potassium. Consequently, a great deal pf potash is consumed here annually. California production of potash comes entirely from the Saline deposits and brines of Searles Lake, San Bernardino County. Virtually the entire output goes for agricultural purposes. Recent annual production is in the neighborhood of 200,000 tons. Phosphorus and nitrogen do not occur in economically recoverable quantities in any California deposits although phosphatic rocks of igneous origin occur in small quantities in San Diego County.

The most important agricultural mineral at the present time is gypsum ($CaSO_4 \cdot 2H_2O$). More than 800,000 tons of the crude product was mined in California during 1947, of which approximately 45% went for agricultural purposes. Much of the agricultural gypsum mined here is gypsite, an impure, earthy form popular in the San Joaquin Valley because of its low cost and accessibility. Gypsum is valuable as a soil additive as a source of sulfur trioxide, a plant food; as a reactive with insoluble potassium silicates to liberate potash; as a stimulant to growth of nitrifying bacteria; as a corrective of black alkali soils; as a slight acidifier of alkaline soils; as a de-flocculator of heavy clay soils; and as a moisture-holding agent in sandy soils.

California gypsum deposits are widespread in occurrence and reserves are adequate for many years to come. As gypsum is a low cost commodity, development of a great many deposits for local consumption to ease freight costs is desirable.

A second agricultural mineral product enjoying widespread quantity consumption is lime. Lime is supplied as a soil additive in a variety of forms. Crystalline limestone, marl, dolomite, and seashells are used in pulverized form without further processing. Air-slaked (hydrated) lime is processed by a variety of chemical and mineral industries from many raw materials and sold for agricultural pruposes in large quantities. Lime deposits are even larger and more widely distributed than gypsum and are inexhaustible in the foreseeable future. Lime, like gypsum, has the power of deflocculating or shrinking clay soils with the result that such soils become more pervious to water and more friable or crumbly to work with. Both there characteristics are of prime importance in farming heavy clay soils. Lime is one of the ten chemical elements essential in plant growth and is itself a plant food. Irrigation and rainfall both tend to remove lime from soils and lime is one of the soil additives which almost constantly needs replenishing, particularly in alfalfa lands. Lime materials also aid the complicated beneficial organic and chemical processes taking place in soils and tend to neutralize over-acid soils.

Sulfur is a third agricultural mineral used in large quantities as a direct or indirect fertilizer. Sulfur is mined at a number of localitites in California but not in adequate tonnages to supply even the agricultural demand. The bulk of the sulfur used in California comes from wells in Texas. Lesser amounts are produced as by-products of some chemical industries. At the present time, it is difficult for California sulfur to compete with the cheap Texas product. Sulfur

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is an essential plant nutrient but only in small quantities. Most soils have sufficient sulfur to supply most plant requirements. Sulfur aids in correction of black-alkali soils and in producing the desired flocculation in heavy clay soils. It is also used in some soils to release other plant nutrient elements and to control other chemical reactions in some soils.

A group of highly porous materials have been in use for some time as soil conditioners partly for their water-retaining (mulching) properties and partly to break up heavy soils. Most of the materials in this class are produced in California except vermiculite, a hydrated mica. Diatomite, pumice, pumiceous volcanic ash, expanded perlite, and vermiculite have all been used for this purpose. All of the above materials except diatomite probably have a small fertilizing value if kept in the soil over a term of years as they tend to break down in the presence of soil waters to slowly release beneficial compounds such as potash. Considerable work is being done at present by various agricultural agencies to determine the effect of the breakdown of different mineral materials in soils. It is not unlikely that these and other natural California products will be found which will add materially to the agricultural mineral reserves of the state.

Diatomite, because of the unique particle shapes contained in it, is one of the best water ratainers and soil lighteners present in California in widespread and abundant supply. However, it is a chemically inert material even in the presence of soil acids and other chemicals and by no means can be regarded as even a latent source of beneficial minerals.

California volcanic ashes have so far not been used as soil conditioners to the extent that they probably deserve. Their use as soil additives is a rather recent innovation here although they have been used in Italy for generations. Although many Italian volcanic ashes are of such unstable composition that they break down more easily than most California types, expanded use of California ash deposits as soil conditioners and possible latent sources of fertilizing materials should be encouraged and experimented with.

Finely divided pumice or pumicite is a valuable mulching material and, like many volcanic ashes, probably has some slow fertilizing value when left in the soil over a reasonably long time period under average soil conditions. Pumice and volcanic ash deposits are known in many strategic places in California and could readily be developed when the demand arises. Expanded perlite or artificial pumice is also finding favor as a soil conditioner and might conceivably decompose, particularly as finely divided particles, in soils in much the same fashion as pumice and volcanic ash. However, natural pumice has the additional advantage of having weathered over an exceedingly long period of time whereas expanded perlite (artificial pumice) is composed mainly of glass.

Vermiculite, a hydrated form of mica, is finding favor as a mulch particularly for use in nurseries where it has been found to be a superior medium for sprouting many varieties of seeds. Here, again, the hydrated or decomposed condition of the potash-bearing mica may be the growth-stimulating factor. More experimental data must be compiled before the true worth of vermiculite and other mulching materials becomes known.

Peat and peat moss are mined in several places in California, mainly for use as a mulch in nurseries. Peat lands are common in large areas of the San Joaquin Valley, particularly those areas bordering San Francisco Bay, and are extensively farmed. Concentrations of plant fibers suitable for harvesting as peat moss are mined by surface operations in several places in Sacramento and Solano Counties.

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MINERAL INFORMATION SERVICE

VOL. 2 January 1, 1949 No. 1

MINING AND INDUSTRIAL NEWS NOTES

Old El Dorado County Lode Mine Reopens

Work is being commenced on the old Caledonia mine property, 2 miles west of Kelsey in El Dorado County, to develop an auriferous pyrite ore body about five feet wide. Work has not been attempted there for nearly 50 years. Wayne Huckaby and sons have installed a 350-foot compressor and are in process of sinking a shaft.

Placer County Drift Mine Reopens

Work has recently been started at the Lee gravel mine located three miles east of Rocklin in Placer County. This old drift mine, on the Tertiary American River, was worked a generation ago through a vertical shaft over 100 feet deep. It contains two horizontal gravel horizons about 50 feet apart. The present operator, H. E. Martin of Sacramento, is in process of running an adit for a new entrance-way. Mr. Martin is working under lease from W. F. Murdock.

Gold Dredge in Trinity County

The bucket line dredge which formerly operated on the Trinity River near Junction City is being dismantled and moved to the Minersville district. The dredge has seventy-two 9½ cu. ft. capacity buckets and can dig to 35 feet below the water line. The dredge will be operated by the Idaho-Canadian Dredging Company, H. B. Murphy, president, which also operates a dredge on the Klamath River near Happy Camp.

NEW DISTRIBUTION CENTER FOR DIVISION OF MINES PUBLICATIONS

The Redding office of the State Division of Mines located at 1739 Yuba Street, is now a distribution point for current and recent publications of the State Division of Mines. This will eliminate the necessity for residents of northern California and particularly the Redding field district to send to the San Francisco office for publications.

THE MOTHER LODE COUNTRY - GEOLOGIC GUIDEBOOK ALONG HIGHWAY 49

Bulletin 141, Geologic Guidebook Along Highway 49, is now being distributed. This is the first of a series of guidebooks to be issued by the State Division of Mines for routes of particular geological, scenic, and historical interest. The Highway 49 guidebook is a semi-technical, semi-popular guide to travelers desirous of information concerning the mines, minerals, rocks, and mining history of the region. It also covers the fine old structures erected during the gold rush period. Ten different authors have contributed to the text and a great deal of original material has been obtained from numerous eminent mining engineers, geologists, anthropologists and historians.

Sierran Roads of Today and Yesterday, by Dorothy G. Jenkins, is a descriptive sketch about the roads traversing the gold country, giving their historical and scenic aspects and summarizing the areas covered by each. The Discovery of Gold in California, by Donald C. Cutter, has to do with the history, life, and romance of the gold rush period and is especially applicable during the current Centennial celebrations. The place of placer gold-mining is well presented in Charles V. Averill's story of the History of Placer Mining for Gold in California. The reader is oriented as to the geologic nature of the Sierra Nevada and the place it occupies relative to history, civilization, and economics by Olaf P. Jenkins' papers on The Sierra Nevada Province and Geologic History of the Sierran Gold Belt. The History of Mining and Milling Methods in California, by C. A. Logan is an interesting summary by a mining engineer intimately acquainted with the gold country for over 30 years. Geologic Maps and Notes Along Highway 49, by Oliver E. Bowen, Jr. and Richard A. Crippen, Jr. consists of a running commentary on the geology, mines, mineral deposits, history, culture, etc., arranged as a traveler would encounter them northbound from the town of Mariposa. Conveniently interspersed with the text are strip maps showing the route geology and the positions of mines, quarries, historical spots, etc. The Formation of Quartz Veins, by John A. Burgess is a lucid treatment of an exceedingly controversial subject written in language the layman can understand. Mr. Burgess is a mining engineer with many years of experience in Mother Lode mining. His second paper, Mining on Carson Hill, a historical sketch on the famous Carson Hill, gives a humerous slant on the discovery of gold near Melones and on later mining ventures there. The charm of the old mining towns, which harmonized so perfectly with the natural loveliness of the Sierran foothills and stand as mute evidence of early development of "industrial minerals" (particularly building materials), is shown in picture and story in A Survey of Building Structures on the Sierran Gold Belt, 1848-1879, by Robert F. Heizer and Franklin Fenenga. The latter is profusely illustrated by 168 photographs and the entire volume contains over 230 photographs.

Cloth-bound copies of Bulletin 141, may be obtained at the San Francisco office or any of the branch offices at a cost of $1.00. California residents should add 2½ percent sales tax.

GEOLOGY OF THE TESLA QUADRANGLE

Cloth-bound copies of Bulletin 140, Geology of the Tesla Quadrangle, California, by Arthur S. Huey, are now being distributed. Announcement of availability of paper-bound copies appeared in the December issue of Mineral Information Service together with a description of the bulletin. Cloth-bound copies may be obtained at the San Francisco office or any of the branch offices at a cost of $2.25.

GEOLOGY AND MINERAL RESOURCES OF ALAMEDA COUNTY

General Geologic Features

Alameda is one of the central Coast Range counties lying on the eastern shore of San Francisco Bay. It contains a land area of 733 square miles and supported a population of 735,000 in 1947. An alluvial plain of Quaternary age, three to eight miles in width trending northwestward, constitutes the west border of the county. This plain rises from the tidal waters of the bay to an elevation of about 100 feet at its eastern inner margin. Here, the Hayward fault, a persistent zone of structural weakness, separates the plain from the uplifted Berkeley Hills range on the east. This is the dominant range in the uplifted block between the bay and Mt. Diablo in Contra Costa County. Along its southwest flank the Franciscan formation of Jurassic age, composed of sandstones, shales, cherts, schists, and associated ultra-basic intrusives of peridotite (altered to serpentine) is exposed. These rocks are overlain conformably by Cretaceous sandstones and shales which extend over the summit of the range east of Hayward. The general dip of the Cretaceous is northeastward and it is flanked on the east by strips of upper and middle Miocene marine sediments forming the west limb of a syncline. The Miocene is in places covered by Pliocene sediments of continental origin interbedded with volcanic flows.

In the southeastern part of the county a maximum elevation of about 3800 feet is attained. Here are located the headwaters of Arroyo Mocho, Arroyo de Valle and Alameda Creek, which form the principal drainage system of the county. These streams flow northwestward to the Livermore Valley covering about 70 square miles in the north-central part of the county, then westward through Niles canyon, meander across the alluvial plain, and discharge into the bay at Alvarado. The surface exposures in this drainage system consist of rocks of the Franciscan formation covering about 110 square miles. This Franciscan-covered area slopes northwestward and is overlain by Quaternary-Pliocene gravels in the low hills which form the south border of the Livermore Valley.

The Livermore Valley is bordered on the north by the southern tip of the Mt. Diablo foothills where volcanic rocks of Pliocene age are exposed. It is closed on the east by the Altamont Hills along whose western base a probable fault has been mapped.

The surface near Altamont is covered by marine sandstones and shales of Upper Cretaceous age which are anticlinal in structure. South of Township 2 South, the Cretaceous is overlain by upper Miocene marine sediments over a wide area, through which the Cretaceous occasionally appears in fault contact. The Miocene near Tesla is flanked on the south by a thin strip of upper Eocene marine sediment. On the west the Livermore Valley is bounded by the Berkeley Hills range, along whose base the Calaveras fault has been mapped.

Mineral Resources

Large resources of salines, sand, gravel, pottery-clay, brick, clay, and miscellaneous stone exist in Alameda County. Sodium chloride (the salt of daily usage) is the principal saline product, and is obtained by solar evaporation of sea water along the eastern shore of San Francisco Bay in the vicinity of Newark. Bitterns from the salt plants are the source of magnesium compounds. The production of magnesium compounds from sea water has largely replaced the use of magnesite as a source material for these products. Additional by-products of salt production are bromine and potash. Clay obtained from Quaternary deposits of the Niles alluvial cone provides the raw material for ceramic and brick-making plants in the county. Small amounts of high grade clays have been produced intermittently from the steeply dipping Eocene beds near Tesla. The excavation of sand and gravel from Quaternary deposits at Niles and from Quaternary-Pliocene deposits in the Livermore Valley constitutes an important phase of the mineral industry of Alameda County. In addition, numerous quarries for the production of crushed rock are distributed throughout the Berkeley Hills from central Oakland to Niles. These quarries are usually located in the cherts and metamorphosed sandstone of the Franciscan formation. A small amount of chromite was produced at Cedar Mountain during the first worldwwar. Coal classed as sub-bituminous was produced from the steep-dipping Eocene beds near Tesla. Over a six year period beginning in 1897, production averaged 70,000 tons annually. There has been no production of coal since 1902. Deposits of manganese associated with the cherts of the Franciscan formation southwest of Livermore produced small quantities of ore prior to and during World War I. A small quantity of manganese ore was also produced during World War II. A moderate amount of pyrite was produced annually from 1901 to 1934. The pyrite occurred at Leona Heights in a narrow belt of rhyolite which extends through the hills from Berkeley to Decoto. The following commercial minerals are known to occur in Alameda County and production in small quantities has been reported: magnesite, limestone (bay shells), glass sand, asphalt, mineral paint, asbestos, travertine, soapstone, copper, lead, silver, and gold.

Significant Activities in 1947

Local clays from the Livermore Valley and from the Niles alluvial cone have been used for many years in the manufacture of sewer pipe, roofing tile, structural shapes, and other clay products. The local clays are usually blended with other clays shipped in from Calaveras and Amador Counties to obtain a working medium having the desired properties.

Sea water bitterns from nearby salt ponds are used at the Newark plant of the Westvaco Chemical Corporation in the manufacture of basic magnesium carbonate. This company also produces bromine in an adjoining plant.

Common salt, sodium chloride, is the chief saline product in this county. It is obtained by solar evaporation of the waters of San Francisco Bay. Large quantities of water are pumped from the bay into intake ponds where the evaporation process begins. As the gravity of the solutions increases they are moved along into concentrating ponds, and finally transferred into crystallizing ponds where the salt crystallizes out in a bed about 5 inches thick. About two years are required to complete the cycle. The ponds of the Leslie Salt Company cover an area of about 25,000 acres fringing the southern end of San Francisco Bay. The actual deposition and harvesting of the annual salt crop occurs at Newark and Mt. Eden in Alameda County. The bed of salt is recovered by mechanical harvesting machines having a capacity of 125 tons per hour. These machines load trains composed of twelve 2-ton bottom-dump cars, powered by 4-ton Vulcan gasoline locomotives running on lightweight, movable, narrow gauge tracks. The salt is hauled to central washing plants, scrubbed in salt water to remove clay or dirt, and conveyed to the crude-salt storage pile. In the adjoining refinery, salt for human consumption is processed to the highest degree of purity in triple-effect evaporators,

A small amount of naturally bonded moulding sand is produced from a steep-dipping 15-foot bed near the old Tesla coal mine. This sand is about 70 percent sand and 30 percent clay and is mined by underground methods. The crude material is run through a hammer mill, delivered to consumers, and used in synthetic facings for medium and heavy iron work.

Stone for concrete aggregate, road-surfacing, and fill-material constitutes the largest mineral item produced in this county. Numerous sand and gravel plants are located in the Livermore Valley and on the Niles alluvial cone. Caterpillar-mounted dragline excavators are usually employed to mine the gravel from open pits. This gravel is transported by trucks or belt conveyor systems from nearby washing and screening plants where the pit-run gravel is crushed, washed, and graded to sizes suitable for concrete aggregate. At the crushed rock quarries, the bank-run material is shovel-loaded to trucks, transported to crushing plants, reduced, and sized. The crushed rock products are sometimes washed although washing is not required on road and fill-material.

NATIONAL STOCK PILE PROGRAM

The Federal Government stock piling program is still active and the following materials are in demand: chrysotile and amosite asbestos, bauxite, beryl, bismuth, cadmium, metallurgical and battery grade manganese, film muscovite, steatite block talc, and zinc. Potential California producers of the above listed materials should submit in letter form an offer quoting a price for the maximum quantity of each grade, type, and size of material which can be delivered to the Government not later than June 30, 1949. Producers are further requested to contact the Treasury Department, Bureau of Federal Supply, Strategic and Critical Materials Branch, Washington 25, D. C. for form TS(SCM)1803, "Suppliers List Application". This single application is all that is required to place a firm or individual on the list of suppliers for strategic and critical minerals. Specifications covering the above listed materials may be obtained at the above address or may be inspected at the State Division of Mines, Ferry Building, San Francisco.

PLACERITA OIL FIELD

Development of the recently discovered Placerita oil field, located in Placerita Canyon about two miles east of Newhall in Los Angeles County, has proceeded rapidly since the last report was published in the November issue of Mineral Information Service. There are now 15 or more wells producing from five to fifty barrels per day of 8° to 16° gravity oil from depths of between 500 and 700 feet. The principal producing companies are Nelson Phillips Oil Company, Indian Oil Company, York Oil Company, and Standard Oil Company of California. Production is coming from late Pliocene and early Pleistocene fine to coarse sandstone. Although reported as a new field, production actually was obtained in Placerita Canyon within ½ mile of the new field as early as 1920. The first successful well that year produced 6 barrels per day of 14° gravity oil which was used for fuel. Structurally the area is one of complex folding and faulting, but occurrence of oil seems to be due chiefly to accumulations in lenticular sands along a westward plunging anticline. The area was long thought to hold small possibilities for oil because of the fact that old crystalline rocks of the basement complex underlie the sedimentary series little more than one mile to the east.

FELDSPAR

The feldspars, a series of aluminum silicates with potassium, sodium, calcium, and rarely barium, are the most important group of rock-forming minerals and constitute about 60 percent of the earth's solid crust. Commercial feldspars are intergrowths of at least two feldspar minerals and one or more accessory minerals such as quartz, muscovite, biotite, tourmaline, and garnet. Kaolinite, a decomposition product of feldspar, is always present to some extent. Pegmatites were the only source of commercial feldspar until recent years when flotation has made possible the recovery of a suitable product from feldspar-rich rocks.

The rock-forming feldspars are complex in composition. They include the alkali feldspars, solid solutions of orthoclase and albite, and the plagioclase feldspars which are solid solutions of albite and anorthite. Plagioclase ranges from pure albite to pure anorthite and broadly speaking, plagioclase in which albite predominates is called sodic plagioclase; when anorthite predominates, it is called calcic plagioclase. Microcline is the nearly pure potassium feldspar, $KAlSi_3O_8$. Celsian (barium), hyalophane (barium-potassium), adularia (transparent orthoclase), sanidine (clear, glassy orthoclase), amazonite or amazonstone (green microcline) and moonstone (transparent or translucent and opalescent orthoclase or translucent albite) are other varieties.

The feldspars as a group have two cleavages at or nearly at right angles, are brittle, often are opaque but sometimes translucent and rarely transparent, and have a vitreous to pearly lustre. The streak is white and not characteristic. In hardness, they range from 6 to 6.5 and in specific gravity from 2.55 to 2.75. Colors include white, gray, brown, pink, yellow and green.

As the most abundant mineral group on earth, the feldspars are found in all classes of rocks, igneous (granites, syenites, porphyries and felsitic lavas), sedimentary (certain sandstones and conglomerates) and metamorphic (gneisses). Pegmatites, irregular dike-like bodies formed from granitic magma emanations, provide the bulk of commercial feldspar. The feldspar may occur as rather large and relatively pure bodies within the dike or mixed with accessory minerals in varying amounts. "Graphic granite" or "corduroy" spar is a mixture of roughly 75 percent feldspar and 25 percent quartz where the quartz is disposed in the feldspar in parallel lines of wedge-shaped grains. Perthite is an interlamination of orthoclase and albite. Cornwall stone or China stone is a semi-decomposed granite containing feldspar, quartz and kaolinite.

The distribution of feldspar is world-wide, but the largest production has been from the United States. North Carolina, South Dakoka, Tennessee, New Hampshire and Colorado are the principal producing states in this country. California has produced small amounts of feldspar through the years. Canada, the Scandanavian countries, Czechoslovakia, Germany, France, Italy, Rumania, Russia, China, India, Japan, Australia, Spain, Palestine, Uruguay, Argentina, Brazil and sections of South Africa are among the many foreign sources. The exhaustion of higher grade deposits plus the shortage and high cost of labor to operate small deposits for a relatively low-priced product has resulted in new sources and improved technique to beneficiate low-grade deposits. Nepheline syenite, an igneous rock containing orthoclase and nephelite, is mined in Canada. Aplite, a mixture consisting almost wholly of feldspar and quartz and occurring in complimentary dikes in granitic masses is being worked in Virginia. Alaskite is another feldspar-rich igneous rock being successfully exploited for its feldspar content. Flotation plants to treat low-grade feldspar deposits are a most important adjunct to the industry and will become increasingly important in the future.

Total production of crude feldspar in the United States in 1945 amounted to 373,054 long tons valued at $2,021,529. Imports of 14,924 long tons of crude feldspar were recorded during the same period. Ground feldspar production amounted to 381,728 short tons in 1945 as shown by merchant mills sales, with no imports. In both cases, the domestic production showed an increase of 13.9 and 11.2 percent respectively. The recorded production in California during 1945-46 was 127 short tons. A large part of the feldspar used by California industries comes from Nevada and Arizona.

Over 95 percent of the ground feldspar produced in the United States is consumed by the ceramic industry and one-half of this 95 percent goes into the manufacture of glass. Both whiteware bodies and glazes for ceramics contain feldspar. Recent practice has been to substitute talc for feldspar in ceramic bodies with equally good results, but to the detriment of the feldspar producer. Enamels for metals, like glazes for ceramics, contain feldspar. Electric and dental porcelains are made from high-grade potash feldspar. Other uses of the feldspar minerals are for roofing granules, as a binder for abrasive wheels, as a base for scouring powders and soaps, in cement manufacture, and for poultry grit.

The majority of feldspar mines are open-cut and quarry operations. Owing to the erratic and irregular nature of pegmatites and the distribution of minerals within the dike, mining usually starts on the outcrop and follows the ore. Because of this, most feldspar mines are small, and development is not carried on much, if any, in advance of actual mining. However, detailed mapping of pegmatites during World War II by the U. S. Geological Survey and exploratory work by the U. S. Bureau of Mines in the search for mica and other strategic minerals has added considerably to the knowledge of the distribution of minerals within the pegmatites. This knowledge should be utilized in future operations to good advantage. More efficient mining methods can undoubtedly be developed by combining geologic data with a judicious drilling campaign to outline the deposit and plan for its economic extraction. Mechanized operations are supplementing many phases of previous, less efficient hand methods. Dry grinding is the most common method of feldspar preparation, and the use of modern crushing and grinding equipment, air separation, screens and magnetic separators has resulted in the production of uniform grades of feldspar for industry. In many operations, mica, both strategic and scrap, plus the many other constituents of the pegmatites, are valuable by-products. Recent flotation tests of one California pegmatite deposit as well as successful feldspar flotation plants now operating in the United States, show that excellent results may be obtained by this method for the differential separation of several minerals. The resulting higher return per ton of crude material is an important economic as well as a mineral conservation factor.

Commercial standards for ground feldspar were published by the U. S. Bureau of Standards in 1930. The essential factors are: (1) physical classification based on fineness of grinding, (2) chemical classification based on composition as it influences use, (3) standard methods for making screen tests, and (4) standard methods for making complete chemical analyses. An optional stardard was published in 1935 by the Feldspar Association to offset criticism of the former in which the principal differences are a classification based upon use rather than analysis, elimination of the alkali ratio, and 3 percent differences in silica content rather than 2 percent. The designations No. 1, No. 2 and No. 3 spar are based upon the relative amounts of silica and feldspars, as well as other impurities. No. 1 spar should be practically free from silica, No. 2 should contain not over 25 percent silica and No. 3 not over 30 percent silica. Each consuming industry has its own specifications as to chemical analysis, impurities, color, size and such.

As is true with any commodity in good supply and low unit cost to the consumer, the marketing of feldspar is most important and highly competitive. Average prices for ground feldspar in 1945 in the United States were \$5.43 per ton for crude and \$11.13 per ton for the ground product. Present North Carolina prices are \$17.00 to \$21.00 per ton (200 and 300 mesh) bulk. The successful exploitation of California's feldspar deposits, which are numerous, will depend upon the operators' ability to mine, prepare and market a uniform, quality product at a competitive price.

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PHOSPHATES

The element phosphorus is essential for healthy plant and animal life and unlike other elements, no substitute is available for it or its compounds. Minute quantities of phosphorus are present in all plants and animals in every cell nucleus, which is the structural element intimately associated with growth and reproduction phenomena. Phosphorus never occurs free in nature, but is widely distributed in minerals, the most important being the phosphates.

Phosphates is a generic term for those salts formed by combining orthophosphatic acid, H_3PO_4, with bases. Phosphorites, the purer forms, are sedimentary calcium phosphate rocks made up essentially of collophane and/or dahllite. Collophane is probably more properly a mineraloid than a mineral and is an amorphous phosphate with considerable calcium carbonate. Dahllite is a crystalline carbonated calcium phosphate with a formula analogous to fluor-apatite. The chief ingredients of the commercial phosphates are the apatite group of minerals.

Apatite is a calcium phosphate containing some fluorine or chlorine and thus is termed fluor-apatite or chlor-apatite, the first being the most common and important. Their formulas can be written as $Ca_4(CaF)(PO_4)_3$ and $Ca_4(Ca\ Cl)(PO_4)_3$. Apatite is transparent to opaque and is usually sea-green to bluish-green in color, but this can range through white to yellow, red, and brown. It is brittle, has a hardness of 5, softer when massive, and has a specific gravity of 3.17 to 3.23. Cleavage is imperfect and fracture is conchoidal to uneven. Apatite crystallizes in the hexagonal system with the crystals varying from long prismatic to short prismatic; occasionally they are tabular. The mineral can be globular and reniform, with a fibrous to imperfectly columnar structure, or massive with granular or compact structure.

Apatite is difficultly fusible, yields a pale bluish-green flame before the blowpipe after being moistened with sulphuric acid, and is soluble in sulphuric and nitric acids. A solution of ammonium molybdate when added to a cold nitric acid solution of phosphate material will give a pulverulent yellow precipitate of ammonium phosphymolybdate.

Apatite is widely distributed in some igneous and metamorphic rocks and is an associate of some iron and tin ores. As minute crystals it has almost universal distribution as an accessory rock-forming mineral in all types of igneous rocks and is an early product of crystallization. The larger crystals are characteristic of the pegmatitic facies of the igneous rocks, especially the granites. In these occurrences, however, it is rarely sufficiently concentrated for profitable extraction. Deposits of apatite in New Jersey, New York, and Virginia have been mined, but only that in Virginia has been exploited in recent years.

The phosphate industry in the United States is dependent upon the natural deposits of phosphate-rock, which is a general term applied to rocks of different degrees of consolidation and of diverse origin and occurrence. These are composed of concentrated mixtures of largely microcrystalline phosphate minerals (usually calcium phosphates) together with various impurities. Fluor-apatite is the predominant phosphatic mineral in all the commercial varieties and grades of phosphate rock produced in the United States. Impurities include calcite, magnesite, dolomite, pyrite, limonite, quartz, clays, and organic matter.

The numerous phosphate-rock types range in color from white to coal black and from soft unconsolidated phosphatic clay, sand and gravel to hard, massive, flint-like rock. The specific gravity ranges from 2 to 3. Some types show evidence of organic origin, such as fossil teeth, bones, and shells.

The principal types of phosphate-rock deposits that are mined in the United States are all of marine sedimentary origin. These include deposits which were of present-day commercial grade when laid down or else became so by subsequent subaqueous action; also the phosphatic marls and phosphatic limestones which have been enriched or reworked to commercial grade subsequent to their uplift. Cave guano, which is chiefly bird excrement, is rich in phosphoric acid but has never had more than minor local importance because of the small size of the accumulations.

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Ocean research expeditions have shown the presence of much phosphorite on the ocean floor in different parts of the world, including the floor off southern California. Phosphorite nodules from California are similar to those described from other places. They appear to have been formed by direct precipitation from ocean water, although in an intermittent cycle as shown by layering of the nodules. It is indicated that the ocean water was essentially saturated with tri-calcium phosphate and that changes in the physico-chemical environment caused precipitation on the ocean floor.

Florida is the principal producer of phosphate-rock in the United States. Tennessee and three of the western states, Idaho, Montana, and Utah are the producers of next importance. Altogether, 12 different states have produced phosphate-rock. Certain phosphorus minerals have been found, but not in commercial quantities, in Fresno, Humboldt, Los Angeles, and Monterey Counties, California. Lithium phosphate is produced from the brines of Searles Lake. Phosphate rock reserves in the United States are ample for many hundreds of years.

Phosphate-rock is marketed according to the amount present of tri-calcium phosphate, $Ca_3(PO_4)_2$, also called bone phosphate of lime. (B.P.L.), and iron and alumina. The lower grades contain a 4 percent maximum of iron-plus-alumina, and the higher grades contain a 3 percent maximum. Commercial grades range from 66 to 77 percent B.P.L. Some grades lower than 60 percent B.P.L. are marketed for furnace production of elemental phosphorus and for fertilizer filler.

The largest percentage of phosphate-rock consumed goes into the manufacture of fertilizer, principally super-phosphate. This is produced by treating the ground phosphate-rock with 50 to 60 percent strength sulphuric acid which expels the fluoride or carbonate as hydrogen fluoride or carbon dioxide, leaving a mixture of soluble phosphate and calcium sulphate. This superphosphate when applied to soils, reacts to form dicalcium phosphate, known as "reverted phosphate", which is readily available to growing plant life.

Smaller percentages of the phosphate-rock are used in the production of elemental phosphorus, phosphoric acid, and several phosphate salts which are used for food and chemical purposes. Increasing use is being made of "polyphosphates" for detergents and water softeners.

On November 11, 1948, market prices for phosphate rock mines in Florida ranged from $4.61 per long ton for 66 to 68 percent B.P.L. to $7.31 for 76 to 77 percent B.P.L.

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MINERAL INFORMATION SERVICE

VOL. 2. February 1, 1949 No. 2

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MINING AND INDUSTRIAL NEWS NOTES

Gold Mining

The Belden mine near Buckhorn Lodge, Amador County, has been one of the principal gold producers in the East Belt during 1948. The vein is a stringer lead in granodiorite. It is one of the few smaller gold quartz mines sucessfully reopened since the war. Ore is crushed in a small Marcy mill, and gold and silver are recovered partly by amalgamation and partly by flotation of sulfides. Leon M. Banks is manager, operating for Belden Amador Mines, Inc. of Fort Wayne, Indiana.

California Production of Iron Ore

The Eagle Mountain Mine of Kaiser Co., Inc., located in Riverside County 15 miles northwest of Desert Center, is now the principal source of iron ore feeding the expanding steel plant at Fontana, San Bernardino County. Kaiser bought the property in 1944, mining operations were started in August 1948, and the first ore was shipped to the Fontana steel plant in October 1948. Operations commenced with development of an open pit on the Bald Eagle deposit, one of three major outcroppings in the immediate vicinity. Bald Eagle is credited with five million tons of positive ore, the main or north deposit with 13 million tons, and the south deposit with six million tons. There is an additional quantity of probable ore amounting to 17½ million tons. Iron content of the ore averages 54 percent. Mining is carried on from 30-foot benches on which primary drilling is done with churn drills and secondary drilling with wagon drills and jack hammers. Ore is blasted from the bench face and loaded into 10-yard dump trucks with diesel shovels (later to be replaced by electric shovels). It is hauled down hill and crushed to minus eight-inch dimensions. Ore is then loaded by belt conveyer to a pendulum conveyer which stocks a pile of about 75,000 tons. It is drawn from this stock pile by a reclaiming conveyer to railroad cars in which it travels to Fontana. Eagle Mountain has the advantage of year-round operation compared to seasonal operation on eastern deposits.

Lead, Zinc, and Silver Production at Darwin, Inyo County

The Darwin district mines are currently the leading producers of lead in the state. Substantial amounts of zinc and silver are also recovered. Darwin Mines, an operation of the Anaconda Copper Mining Company, is currently producing one million pounds of lead and zinc per month from concentrates and crude ore. The Darwin district had produced nearly $7,000,000 in lead, zinc, and silver prior to 1945 when Anaconda purchased the major producing mines. Ten tons of shipping ore are produced per day and the mill is currently milling 300 tons of lead-zinc sulfide ore per day, producing separate lead and zinc concentrates. The ore occurs in three genetic types: replacements in tactite (contact altered, silicated limestone), replacements in favorable bedding horizons, and fissure fillings or veins. The host rocks are Paleozoic limestones, dolomites, and quartzites which have been intruded by granite, granodiorites, and gabbroic intrusives of several types.

WATER-FLOODING AS A POSSIBLE MEANS OF INCREASING CALIFORNIA OIL PRODUCTION

The consumption of crude petroleum in California during the past few years has increased to unprecedented levels. California operators have been hard pressed to meet these demands, for the discovery of new oil pools has not kept pace with the necessarily increased rate of production. Although the current crude oil reserves situation is not imminently acute, operators are looking toward the near future when they might not find it possible to meet the demand for oil.

The prospects of finding sufficient new fields to bolster petroleum reserves to the desired level do not appear to be favorable. Consideration must, therefore, be given to other means of meeting this important problem. It has been estimated that but 25 to 35 percent of the oil originally present in petroleum reservoir sands will ultimately be recovered by primary production methods. By the proper application of secondary recovery methods, it has been possible in some areas to recover an additional amount of oil equal to the total amount recovered during the primary period of production. The injection of water into oil sands for the purposes of secondary recovery has met with a high degree of success in many other oil producing regions of the country.

A report entitled Water-Flooding As a Possible Means of Increasing California Oil Production will appear in three parts in successive issues of the Journal of Mines and Geology beginning April 1949. The first part of this report is a review of the many factors influencing the application of water-flooding and a brief correlation of these factors to California oil reservoir conditions. The second part of the report is a comprehensive survey of California conditions relative to the application of water-flooding. Also included in this part of the report is a review of the limited water-flooding experience in California to date. An analysis of California conditions indicates the need for considerable laboratory and field research before water-flooding might be successfully applied. These problems are outlined in the concluding part of the report and a plan of coordinated research is presented.

The report is written by Wilbur H. Somerton, Assistant Professor of Petroleum Engineering in the Division of Mineral Technology, College of Mining Engineering, University of California, Berkeley.

ESTIMATE OF CALIFORNIA MINERAL PRODUCTION, 1948

The total value of mineral production in California for the year 1948, as estimated by the Economics Section, is $1,099,703,000. The year's output is detailed in part in the tabulation below. As more than sixty mineral substances are produced in the state, estimates are possible on only the most important at this date. Requests for reports on 1948 production are being mailed to all producers by the U.S. Bureau of Mines in cooperation with this division, and a complete report will be published when the returns have been received and compiled. The preliminary figures given below on copper, lead, gold, silver, and zinc are estimates of the U.S. Bureau of Mines.

The estimated total of $1,099,703,000 is an increase of approximately $245,590,000 over the 1947 total of $854,113,000 and is the largest mineral output for any year on record. This was the result of record petroleum and natural gas production coupled with the highest average prices ever paid in this state. Increases were registered in quantity and value of cement, miscellaneous stone, salines, and some industrial minerals. All metals registered a decrease in quantity of ore mined but the value of lead and zinc was slightly higher than that of 1947.

The petroleum output for 1948 increased approximately 5,582,000 barrels or about 2 percent in quantity and about $220,833,000 in value, approximately 39 percent over the 1947 total. The large increase in value was the result of several price increases in 1947, the last being a raise of 50¢ per barrel effective December 27, 1947, on all grades of crude oil. The output of natural gas, natural gas gasoline, and liquefied petroleum gases all showed increases with record total values. The output of the cement mills was at an all-time high for the year, and miscellaneous stone also showed a large increase owing to programs of private and public construction.

PRELIMINARY FIGURES ON MINE PRODUCTION OF GOLD, SILVER, COPPER, LEAD AND ZINC IN CALIFORNIA IN 1948, BY MONTHS, IN TERMS OF RECOVERABLE METALS

	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January . . .	40,330	68,800	40	840	90
February . .	38,670	65,200	40	720	90
March	35,100	64,000	40	840	70
April	31,880	68,900	20	880	100
May	36,000	48,200	20	660	350
June.	34,800	60,600	50	820	530
July.	33,500	49,100	50	630	550
August. . . .	36,780	60,900	30	820	690
September . .	34,330	45,300	40	550	530
October . . .	32,470	50,000	30	660	600
November. . .	31,630	53,200	50	720	660
December. . .	33,000	51,000	40	700	620
Total 1948. .	418,490	685,200	450	8,840	4,880
Total 1947. .	431,415	1,597,442	2,407	10,080	5,415

Prepared by
R.B. Maurer,
San Francisco Office, U.S. Bureau of Mines

TABULATION OF TOTAL ESTIMATED MINERAL PRODUCTION IN CALIFORNIA FOR 1948

Gold	$14,647,000	(418,490 fine ounces)
Silver	620,000	(685,200 fine ounces)
Copper	81,000	(900,000 pounds)
Lead	3,940,000	(17,680,000 pounds)
Zinc	1,298,000	(9,760,000 pounds)
Mercury	801,000	(10,600 flasks)
Other Metals	2,225,000	(including chromite, iron ore, manganese ore, molybdenum ore, platinum group metals, and tungsten ore.)
Petroleum	792,521,000	(338,684,000 barrels)
Natural Gas	74,000,000	(570,000,000 M cu. ft.)
Natural Gas Gasoline	47,000,000	(845,700,000 gallons)
Liquefied petroleum gases	9,800,000	(272,000,000 gallons)
Cement	49,670,000	(24,700,000 barrels)
Miscellaneous stone	38,500,000	
Clay products	15,000,000	Heavy clay products other than pottery and refractories.
Other industrial non-metallic minerals	20,600,000	including clay, gypsum, lime, mineral water, pumice, silica, talc, and others.
Salines	29,000,000	including borates, iodine, potash, magnesium salts, salt, soda, and others.
Total	$1,099,703,000	

77TH ANNUAL NATIONWIDE MEETING OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

The American Institute of Mining and Metallurgical Engineers will hold its 77th annual meeting at the Fairmont and Mark Hopkins Hotels, February 13-17 inclusive. Founded in 1871, the A.I.M.E. now comprises more than 16,000 engineers and technologists many of which are identified with a great many industries other than that of mining. A Pacific Coast meeting (annual meetings are almost invariably held in New York) is exceedingly appropriate during the current one hundredth anniversary celebrations of the discovery of gold in California. The San Francisco Section of the Institute under the chairmanship of W.W. Mein, Jr. plans to make the visit a memorable one and a high light of the anniversary celebrations.

The program will begin with meetings on Sunday afternoon and end with a post-meeting field trip on Friday, February 18. Many are planning to take a 10-day trip by air to Hawaii immediately following the meetings for which an elaborate island-hopping program has been arranged. Several short airplane excursions over the San Francisco Bay region have been arranged through the courtesy of Pan American Airways. Itineraries of both ground and air excursions are included in this issue of MINERAL INFORMATION SERVICE. Sixty six technical sessions are planned and approximately 150 papers will be presented. Outstanding programs have been arranged by each of the groups that participate in Institute activities. The complete program will be available during registration and appears in the January 1949 issue of "Mining Engineering". Most of the technical sessions begin either at 9:45 a.m. or 2:00 p.m. These will be open to both members and non-members but non-members are required to pay a $5.00 registration fee. Student engineers may attend free of charge.

San Francisco hotels will be crowded so advance reservations are urged. For reservations write the A.I.M.E. Housing Bureau, Room 200, 61 Grove Street, San Francisco 2, enclosing a deposit of $5.00 per person or $10.00 per room.

GUIDE TO AIRPLANE TRIP OVER THE SAN FRANCISCO BAY AREA

Airplane flights covering points of cultural, industrial, mining, and geologic interest are being scheduled for February 15, 16, and 17. These will be made through the courtesy of Pan American Airways at no cost other than transportation to and from the air field. Planes used will be DC-4 Clippers and flights will commence at Mills Field, San Francisco Airport.

Planes will take off northward and head toward the entrance to San Francisco Bay. The trace of the San Andreas fault can soon be seen to the left and the San Francisco West Bay industrial district on the right. The Golden Gate will be crossed close above the Golden Gate Bridge and the flight will continue across Marin County along the rift valleys of Bolinas and Tomales Bays. Horizontal displacements of 21 feet were recorded along this part of the San Andreas rift system at the time of the earthquake of 1906. The route will swing east in the vicinity of the town of Inverness on Tomales Bay and pass over Marin Peninsula, rocks of which are mainly of the famous Franciscan formation. The northern arm of San Francisco Bay, (known locally as San Pablo Bay) is then crossed and the plane will pass over the Mare Island Navy Yard west of Vallejo. From Mare Island the route lies along the Carquinez Strait and ship canal to the Pittsburg industrial district. In addition to the great Columbia Steel Plant this district boasts extensive clay and sand pits visible from the air. The plane will fly over the low Montezuma Hills and Rio Vista gas field. The Montezuma Hills are the surface expression of a part of a low dome. The average depth of the gas wells is 4200 feet and production comes from about 500 feet of Eocene sands. Many of the wells produce from beneath the Sacramento River system. After circling the Rio Vista gas field the plane will turn westward to pass over the Columbia Steel Mill. Mt. Diablo and its surrounding foothills can be seen upon the left (S). Tertiary sediments in the Mt. Diablo district contain coal which was once the chief fuel for the river steamers which plied the Sacramento River prior to the advent of the transcontinental railroads.

Continuing west the huge Naval ammunition dump at Port Chicago; the Tidewater Associated Oil Refinery at Martinez; the American Smelting and Refining Co. refinery (with its huge stack) located near the Carquinez bridge; the Union Oil Refinery at Oleum; and the Hercules Powder Works near Pinole can be seen.

The plane will swing south over the northern end of the Berkeley Hills which, in general, is an upthrown syncline bounded by faults which parallel the San Andreas rift system. To the west, the Standard Oil Refinery at Richmond can readily be seen. Following along the west edge of the Berkeley Hills the plane will pass over the Univeristy of California with its prominent white campanile or belltower. A short distance southwest of the University the enormous installations of the Naval Air Base and Army and Navy Supply Depots may be seen. The route will continue southeast along the hills above the Haywards fault system. Offset streams may be seen along this fault between Hayward and Niles. West of Niles the desiccation basins of the Leslie Salt Co. and Westvaco Chlorine Products Corp. form a prominent patchwork. At Niles the hills pass into the Mount Hamilton Range. Mount Hamilton located east of San Jose, the highest peak in the Hamilton Range, is the site of the Lick Astronomical Observatory of the University of California.

Turning west the plane will fly over San Jose and approach the Santa Cruz Mountains. A plume of smoke usually marks the Henry J. Kaiser Permanente Cement plant and its great limestone quarry. During the war Kaiser produced magnesium metal and incendiary bombs.

Near Permanente, the plane will turn north and fly over Stanford University. The San Andreas fault trace may again be seen to the west. Crystal Springs Lakes (artificial) lie exactly on the fault. The plane will then begin its descent to return to Mills Field. Professor V.L. Varderhoof of the School of Mineral Science at Stanford University will accompany the flights, pick out the main points of interest and give interesting commentary on them. The trip will take about one hour and bus transportation to the airport will be provided. Tickets are sold with the understanding that the A.I.M.E. and the San Francisco section assume no liability.

REFERENCE LIST OF RECENT PUBLICATIONS

The references listed below are available for study in the Library of the Division of Mines but are not on sale by the Division.

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SUPPLEMENT TO MINERAL INFORMATION SERVICE

GEOLOGIC GUIDE

AN EXCURSION THROUGH THE SAN FRANCISCO BAY AREA

For visiting mining engineers and geologists who are meeting on various occasions in the San Francisco Bay Area during this Centennial season, a geologic map and guide for a one-day excursion have been prepared by the Division of Mines. Knowing that many of the readers of MINERAL INFORMATION SERVICE are particularly interested in becoming intimately acquainted with rock exposures, mineral deposits, and the early developments of our natural resources, we are including this map and guide as a supplement to the February issue of M.I.S.

The Bay Area has recently taken on a new industrial growth and is calling for raw mineral materials to provide its industries with the things it needs for making finished products. It behooves us, therefore, to know our own surroundings and to share this knowledge with those who come to visit.

The rock formations and structures typical of the Coast Ranges are exposed near at hand in the Bay Area. Historically the region is one of the most significant on the continent. It is the cradle of English speech in North America, since Francis Drake in 1579 was the first Englishman to take possession of the country in the name of the English monarch. His occupation lasted only five weeks, but he was received and honored by the natives who crowned him as their chief god whom they called "Hyoh". Sixteen years later Cermeño named Drake's Bay the "Bay of San Francisco". The discovery of the present San Francisco Bay was not made until Nov. 1, 1769 when the expedition by Portolá searching for Monterey Bay viewed the great inland valley and sea from Montara Mountain. They stood upon this mountain of granitic rock and looked down upon the gulf of the Farallones and Point Reyes, 40 miles to the north. They followed a trail and camped on the site of the present San Andreas and Crystal Springs Lakes which occupy the rift zone of the San Andreas fault. The discovery of San Francisco Bay gave to the world one of its best harbors. In the Gold Rush days it served as the heart of the new mining industry which suddenly developed the entire West and influenced the whole world. Today the metropolitan areas of the region are rapidly growing and coalescing into one of the world's greatest centers of industry, commerce, education, and homes.

On the shore of a small inlet (now Drake's Bay) 30 miles northwest of the Golden Gate, Francis Drake beached his Golden Hinde 370 years ago (June 17, 1579, Old Style) and took possession of the region in the name of Queen Elizabeth. He named the country New Albion because the white cliffs "which lie toward the sea" reminded him of those of his own country. The cliffs expose beds of white diatomaceous shale well known, especially to oil geologists, as the Monterey formation.

According to Drake's chronicler, a plate of brass was nailed to a great and firm post with an inscription that declared his possession of the land in the name of Queen Elizabeth. Three and a half centuries later (1936) this same brass plate with its inscription was discovered, authenticated, and presented to the world through publication by the California Historical Society. The plate was found by accident on top of a hill overlooking San Quentin and San Francisco Bay, probably carried to this spot by various persons, perhaps originally by the same Indians who honored Drake in those early days.

A search for evidence of the early history of exploration of this west coast is now being directed towards the objects found buried in the shell mounds where early Indians had their feasts. Old iron ship's spikes and fragments of sixteenth-century Chinese porcelain have been unearthed, which tell the tale of the wreck of Cermeño's ship, the San Agustin, in Drake's Bay in 1595.

The founding of San Francisco came in 1776 when the Spanish explorer Anza selected the site of the Presidio and when the Mission Dolores was dedicated. The growth of the city to one of world fame came in 1849 with the influx of the Argonauts who had been lured by the news of the discovery of gold made at Coloma, January 24, 1848, by James Marshall.

Sonoma, a town 45 miles north of San Francisco, is where the Bear Flag of the short-lived "California Republic" was raised in 1846, marking the beginning of a transitional period, during which California was ceded to the United States (Feb. 2, 1848). This period ended when California became a full fledged State on Sept. 9, 1850.

In the region about Sonoma and the area north of the Bay, paving blocks were cut from Tertiary basaltic lava flows and these blocks were sent to San Francisco to make its streets.

Limestone deposits suitable for making lime are not common on the coast, but apparently the early settlers found a few, for their ancient kilns stand as mute evidence of early appreciation of this important natural resource.

Russians entered the California coast and founded Fort Ross in 1812. Later they established a trading post at Bodega Bay. As fur traders they clashed with the Spaniards, who would not let them enter the Golden Gate. This resulted in illegal trading by way of Drake's Bay.

Earthquakes form a continuous and important part of the history of California. Records of shocks go as far back as 1769. Of the three or four greatest earthquakes recorded in the state, that of April 18, 1906 was the most significant. It was caused by actual and visible earth movement along a 270-mile portion of the San Andreas fault, which is at least 600 miles in length and one of the major active earth displacements of the world.

The rock formations and structures on the two sides of the San Andreas rift form two distinct geologic provinces. Those on the west are characterized by a basement of granitic rock; those on the east are underlain by the Jurassic Franciscan sediments, serpentine, volcanic, and metamorphic rocks. The overlying Tertiary sediments on the granite basement are for the most part flat lying, while those on the Franciscan rocks are often found contorted.

The following log and map have been arranged to bring out many of the interesting and characteristic features of the geology, history, and mineral resources of the region.

GEOLOGIC GUIDE--LOG OF EXCURSION (to accompany map)

(See Pages 12-13)

Speedometer reading

00.0 Ferry Bldg. Leave 8:00 a.m. Drive south on the Embarcadero four blocks, turn right on Harrison St. Go four blocks then turn left on Fremont; approach to Bay Bridge....01.2 Enter Bay Bridge...03.5 Yerba Buena Island. Tunnel through sandstone and shale of the Franciscan formation (Upper Jurassic)....06.9 Toll station at east end of bridge....07.6 Left turn following U.S. Highway 40....09.1 Leave U.S. Highway 40 and follow State Highway 24 to the right through south part of Berkeley....12.3 Turn left on Claremont Ave....12.5 Keep right on Claremont Ave. Approximate location of the Hayward fault and contact of the Franciscan formation with the Cretaceous shale and sandstone....13.5 Approximate location of the contact between the Cretaceous and the upper Miocene (siliceous) Claremont shale and chert (Monterey formation)....13.7 Trace of Wildcat fault in Claremont shale. Cherts and shales highly contorted.

13.8 STOP A - 10 minutes. Quarry in Claremont formation, chert with limestone lenses. Beds are almost vertical and locally overturned; partly result of soil creep. Contact with the Orinda formation (Pliocene) is in the small gully to the east of the quarry....14.1 Good exposures of Orinda formation in road cuts all along the upper reaches of Claremont Canyon....14.5 Junction with Skyline Drive and Grizzly Peak Blvd. Turn left on Grizzly Peak Blvd....14.8 Orinda formation. Conglomerate.

14.9 STOP B - 10 minutes. Contact of Orinda formation and Grizzly Peak basalt (Pliocene). The latter is a vesicular, amygdaloidal olivine basalt. The bright red color, a prominent feature of the contact, resulted from baking of the rocks by the lava flow. The road cuts expose a series of flows, agglomerates, and interflow sediments....15.4 Siesta formation (Pliocene). Consists of fossiliferous lake deposits; limestones, shales, and water-laid tuffs....15.5 Bald Peak basalt (Pliocene). Similar to Grizzly Peak basalt, but consists of younger flows....16.1 Re-enter the Siesta formation. Cherts contain fresh-water ostracods....16.3 Road crosses a NE-trending fault which has offset the Siesta formation about 200 feet to the east. This fault also offsets the Wildcat fault and is, therefore, younger.

16.4 STOP C - 15 minutes. Grizzly Peak. Fine view of Golden Gate and Bay region. Farallon Islands 45 mi. W. Mt. Tamalpais 20 mi. NW. Montara Mt. 30 mi. SW. University of California is visible at the mouth of Strawberry Canyon. Cyclotron is on slope. The abruptly ending mountain spurs directly back of the campus mark the Hayward fault. In the canyon to left is the cross fault noted above. The aligned hills about halfway down the canyon mark the Wildcat fault in the Miocene. (See also the map and the cross sections XX' and YY'.) Rock exposures in road are the Grizzly Peak basalt flows.

17.3 STOP D - 10 minutes. Little Grizzly Peak. The rock on Little Grizzly Peak is a rhyolite breccia, probably a plug (see section XX' on map). The Wildcat fault, in the low saddle to the east of Little Grizzly Peak completely cuts out the Claremont shale and greatly thins the Orinda conglomerate....17.4 Grizzly Peak basalt....17.6 Continue on Grizzly Peak Blvd. Rocks along road are mainly Grizzly Peak basalt with scattered patches of rhyolite. Berkeley Hills....18.9 Contact of Grizzly Peak basalt and Orinda conglomerate; not well exposed....20.0 Summit Reservoir. Do not turn left but continue straight ahead....20.2 At top of hill, turn left on Beloit Ave....20.3 Contact of Orinda and Franciscan formations under soil cover....20.5 Beloit Ave. ends; turn right on Cambridge Ave....20.7 Cambridge Ave. ends; turn left on Wellesley Ave....20.9 Wellesley Ave. joins Arlington Ave.; turn right on Arlington Ave....21.2 Exposures of serpentine in the Franciscan formation on the right.

21.5 STOP E - 10 minutes. Arlington Ave. near Cowper, exposure of silica-carbonate rock, which is an alteration product of serpentine....22.1 Enter Arlington Estates. Continue on Arlington Ave....22.5 Hayward fault zone. Although not visible from road, the fault is the contact between the Franciscan and the Orinda formations. It is exposed in large quarry to the right behind the horse corral....23.0 Serpentine exposures....23.1 Small hills to the left of the road are serpentine (upper Jurassic) capped with rhyolite (Pliocene)....23.8 Arlington meets Cutting Blvd. Turn left on Cutting.

23.9 STOP F - 10 minutes. Collecting locality for glaucophane schist with garnet, actinolite, and other contact metamorphic minerals developed in the Franciscan formation in contact with serpentine. El Cerrito. Follow down Cutting Blvd. to the west....24.6 Cross San Pablo Blvd. (U.S. Highway 40) Continue on Cutting Blvd., following the San Rafael Ferry sign. Richmond....25.7 Pullman Ave. ....28.1 Turn right, then left on Standard Ave....29.1 Standard Oil of California, Richmond refinery....29.4 Franciscan sandstone in the quarry on right....29.9 Keep to left, following San Rafael ferry sign....30.0 Blake Brothers crushed rock quarry and plant....30.5 Richmond-San Rafael ferry toll station. Ferry leaves 11:08 a.m. (and every 20 minutes). See map in saloon of ferry boat for identification of geographic features....31.2 Leave ferry mole, turn right. Road to left goes to San Quentin State Prison. Rocks are Franciscan sandstone and basalt....31.9 Turn left on road which climbs hill....32.6 Gate to the San Quentin State Prison on the left side of road....33.1 Old brick kiln on right. Remillard Brick Co.; built 1891; capacity 12,000,000 bricks a year....33.2 Hutchinson Co. crushed rock quarry and plant; Franciscan sandstone and basalt....33.6 Cross U.S. Highway 101 and continue straight ahead. Drake's plate was found on ridge to right....33.8 Kentfield, College of Marin....36.5 Ross....37.5 San Anselmo. At the stop sign turn left on Sir Francis Drake Highway. Red Hill directly ahead is weathered basalt of the Franciscan formation....39.2 Fairfax Road to left goes to Alpine Lake and Mt. Tamalpais....39.4 Franciscan formation....41.7 Franciscan shale and sandstone, prominent landslide topography.

42.0 STOP G - 10 minutes. At summit of grade. Excellent exposure of Franciscan shales and sandstones....43.0 Redwood grove (Sequoia sempervirens)....43.2 Woodacre....44.7 San Geronimo. Junction with road from Nicasio and Petaluma....45.5 Silica-carbonate rock on the right side of the road near Lagunita School. Serpentine on the hills north and west of the school....45.8 Franciscan sandstone....46.1 Forest Knolls....46.7 Lagunitas.

47.1 STOP H - 10 minutes. Basalt porphyry, some phases almost gabbroic, showing pillow structure in part of the exposure....48.2 Samuel Taylor State Park;

redwood grove....48.5 Spring....49.6 Enter picnic area of Samuel Taylor State Park. Turn left into park; cross the bridge; turn right.

STOP I - 10 minutes. Redwood forest. Rocks through here are Franciscan sandstone. Follow along the bank of the river....50.9 Turn right and cross bridge.... 51.0 Join main highway. Turn left. Franciscan sandstone....53.5 Tocoloma. Rocks at west end of bridge are silica-carbonate rock.

54.1 STOP J - 10 minutes. Franciscan sandstone. Entering the valley of the San Andreas rift zone. Typical landslide topography. The mountain on the opposite side of the rift valley consists of granitic rock, quartz diorite (pre-Franciscan) which intrudes the Paleozoic (?) Sur series and is overlain by the Monterey formation (upper Miocene). Tomales Bay to the right represents a submerged portion of the San Andreas rift valley....55.1 Olema. Turn right on State Highway 1, along east side of rift valley....55.2 Turn left on oiled country road which crosses and is within the rift zone....55.5 Small hills in rift zone are composed of Pleistocene gravels and sands.

55.8 STOP K' - 5 minutes. Bear Valley Ranch, where maximum horizontal displacement of San Andreas fault in 1906 measured 21 feet. On April 18, 1906 the San Andreas fault moved, causing one of the greatest earthquake shocks recorded in recent history. Surface movement extended for 270 miles along the rift from San Benito County on the south to Humboldt County on the north; displacement was horizontal; direction, N 35° W; the west side moved northwestward relative to southeast side. In 1907 the State Earthquake Investigation Commission erected fault monuments which are visible on either side of the road.

57.0 STOP K - 15 minutes. The trace of the 1906 movement in the San Andreas rift is visible along west flank of the small hills to the right of the road and in the quarry just past the ranch gate. Rocks are soft, poorly consolidated Pleistocene deposits....57.6 Junction with Sir Francis Drake Highway....57.8 Laguna Ranch road joins highway from left. 1.1 miles off highway is a very old abandoned quarry in white crystalline Paleozoic (?) limestone. The limestone is intruded by a granitic rock, quartz diorite, age unknown....58.9 Quarry on left side of road is reworked quartz diorite debris (probably Pleistocene). Road follows west side of rift valley....59.7 Inverness....60.5 Quarry on left side of road, deeply weathered quartz diorite. Road turns inland from shore of Tomales Bay....61.3 Pierce Ranch road, leading to within a few miles of Tomales Bluff, turns off to right. Follow Sir Francis Drake Highway to the left.

62.3 STOP L - 10 minutes. Quarry in weathered quartz diorite.

62.7 STOP M - 10 minutes. Quarry in Miocene (Monterey formation) diatomaceous chert and shale. Strata lie in nearly horizontal position in contrast to the steeply dipping Miocene (Claremont shales) of the Berkeley Hills area. (Road continues 12 miles to the Point Reyes Lighthouse.)....68.1 Inverness....72.0 Point Reyes Station junction with State Highway 1, turn right, south....74.0 Olema. Follow State Highway 1. Franciscan formation lying within the San Andreas rift zone has been crushed by fault action....78.3 Serpentinized peridotite.

78.5 STOP N - 15 minutes. Limestone quarry and old kilns (cannot be seen from the road); located along the stream to the right of the highway. The large tree now growing from the middle of one kiln has been dated from tree rings (in 1935) as being 128 years old, placing the operation of the kilns prior to 1807. Perhaps the kilns were first operated by the early Franciscan mission fathers or possibly by Russians who made a settlement at Fort Ross in 1812 and later had a trading post at Bodega Bay. The limestone is a pink to gray fine-grained well-bedded, cherty rock, occurring as a lens in the Franciscan formation. Typical rift valley topography: Note the side hill ridges. sag ponds, steep sided, aligned hills, and incomplete drainage system....83.4 Turn left; follow State Highway 1. Road straight ahead goes to Bolinas. The Merced formation (Pliocene) at Bolinas contains foraminifera, some visible to the naked eye....83.8 Cliffs along the road are conglomerates; probably Pliocene or Pleistocene fanglomerates....88.7 Stinson Beach....88.9 Junction with road to Mt. Tamalpais. Continue on State Highway 1....89.6 Franciscan basalt weathered and shattered.

89.7 STOP O - 10 minutes. View of Bolinas Bay which lies on San Andreas rift. Quarry to right exposes highly contorted typical manganiferous cherts of the Franciscan formation....90.1 Serpentine.

90.5 STOP P - 10 minutes. Serpentine exposed in road cut. Down the hill to the right is a small lens of black Franciscan limestone appearing white on the weathered surface....95.0 Junction at Muir Beach; road to the left goes to Muir Woods. Continue on State Highway 1. Franciscan sandstone and chert....101.5 Junction of State Highway 1 and U.S. Highway 101. Turn right on U.S. Highway 101. Franciscan sandstone and shale....104.2 Excellent exposure of Franciscan pillow basalt along the west side of the highway....104.4 Tunnel....104.9 Franciscan cherts with small layers of red shales between beds dipping SW....105.3 Enter Golden Gate Brid e....112.5 Return to Ferry Bldg. in San Francisco.

THE WESTERN PULP AND PAPER INDUSTRY AS A CONSUMER OF MINERALS AND INORGANIC CHEMICALS

The following passages are excerpts from a paper presented by R.G. Mispley before the Western Chemical Market Research Groups - A Pacific Industrial Conference, Pacific Chemical Exposition, Civic Auditorium, San Francisco, California, October 21, 1947. The complete paper will be published in the California Journal of Mines and Geology for July 1949.

The pulp and paper industry is a large consumer of chemical raw materials. These chemicals are used throughout all stages of the manufacture from that of pulping to the final finishing of the product. Some are processing agents to release the cellulose fibre from its non-fibrous associated constituents while others become an integral part of the product and provide the industry with its reputation for diversification of commodity.

TABLE I

Pulp and Paper Production during 1946

Western States Pulp Production		1,754,000 tons
Washington	1,333,000 tons	
Oregon	407,000 tons	
California	14,000 tons	
British Columbia	500,000 tons	
Western State Paper Production		1,565,000 tons
Washington	725,000 tons	
Oregon	390,000 tons	
California	450,000 tons	
British Columbia	400,000 tons	
Western States, including British Columbia, Proposed Expansion Through 1948		
Pulp	500,000 tons	
Paper	500,000 tons	

Minerals and inorganic chemicals used for primary pulp production are sulphur, limestone, lime, salt cake, soda ash, and caustic soda.

Sulphur - This basic raw material of the sulphite process is burned to form SO_2 which is reacted, in the presence of water, with limestone (or one of the other bases) to form a mixture of calcium bisulphite and sulphurous acid. From two to three hundred pounds of sulphur are required per ton of pulp.

Sulphur is also used in the sulphate process either as elemental sulphur to provide proper adjustment of the cooking liquor, or reacted with soda ash to produce synthetic salt cake.

Sulphur, which comes from Louisiana and Texas, is being used at the rate of approximately 400,000 tons annually in the pulp and paper industry, which quantity is about ten percent of the total production. Pacific Coast requirements are 145,000 tons.

Limestone - Limestone is used in the manufacture of sulphite cooking liquor to the extent of 440,000 tons annually. Of this total, we use 173,000 tons, the source of which is local.

Lime - The major percentage of lime is consumed in the sulphate and soda processes. An efficient lime recovery in these processes precludes a much greater usage. Some lime, essentially dolomitic, is used for the preparation of sulphite cooking acid. It is also a basic ingredient for producing calcium hypochlorite bleach liquor and in the bleaching process, and for the cooking of rags and straw.

Current annual usage is 500,000 tons, about twelve percent of the total production. About 50,000 tons are used in the Western industry.

Salt Cake - Salt cake, sodium sulphate, reduced to the sulphide, is the basic component of the sulphate pulping process. Its concentration is maintained at a predetermined level in the cooking liquor to produce the particular pulp desired in the mill. This chemical is derived from three sources: natural, synthetic, and by-product.

The sulphate process depends for its economic success entirely upon the efficiency of chemical recovery. Inasmuch as this percent recovery varies quite widely, we can only say that salt cake usage likewise varies over relatively wide limits. Normally, from approximately one hundred seventy-five to four hundred pounds per ton of finished pulp are required.

The industry current consumption, practically the entire production, is 650,000 tons. Pacific Coast usage of about 60,000 tons is mainly from natural deposits in California.

Soda Ash - Soda ash, sodium carbonate, is a source of alkali in preparation of the sulphate and soda cooking liquors. One purpose is to adjust to the final causticity, reducing the sulphidity to the desired percentage. In the soda process, soda ash is the essential chemical for liquor makeup.

A furthur, very important use is that it is the alkali used in the cooking of rosins for the preparation of rosin size. Soda ash, in conjunction with other alkalis, and miscellaneous materials, is used in the de-inking process for the reclaiming of waste papers.

Current consumption is about five percent of the total production at the rate of 150,000 tons annually, 10,000 tons of which are used on the Coast.

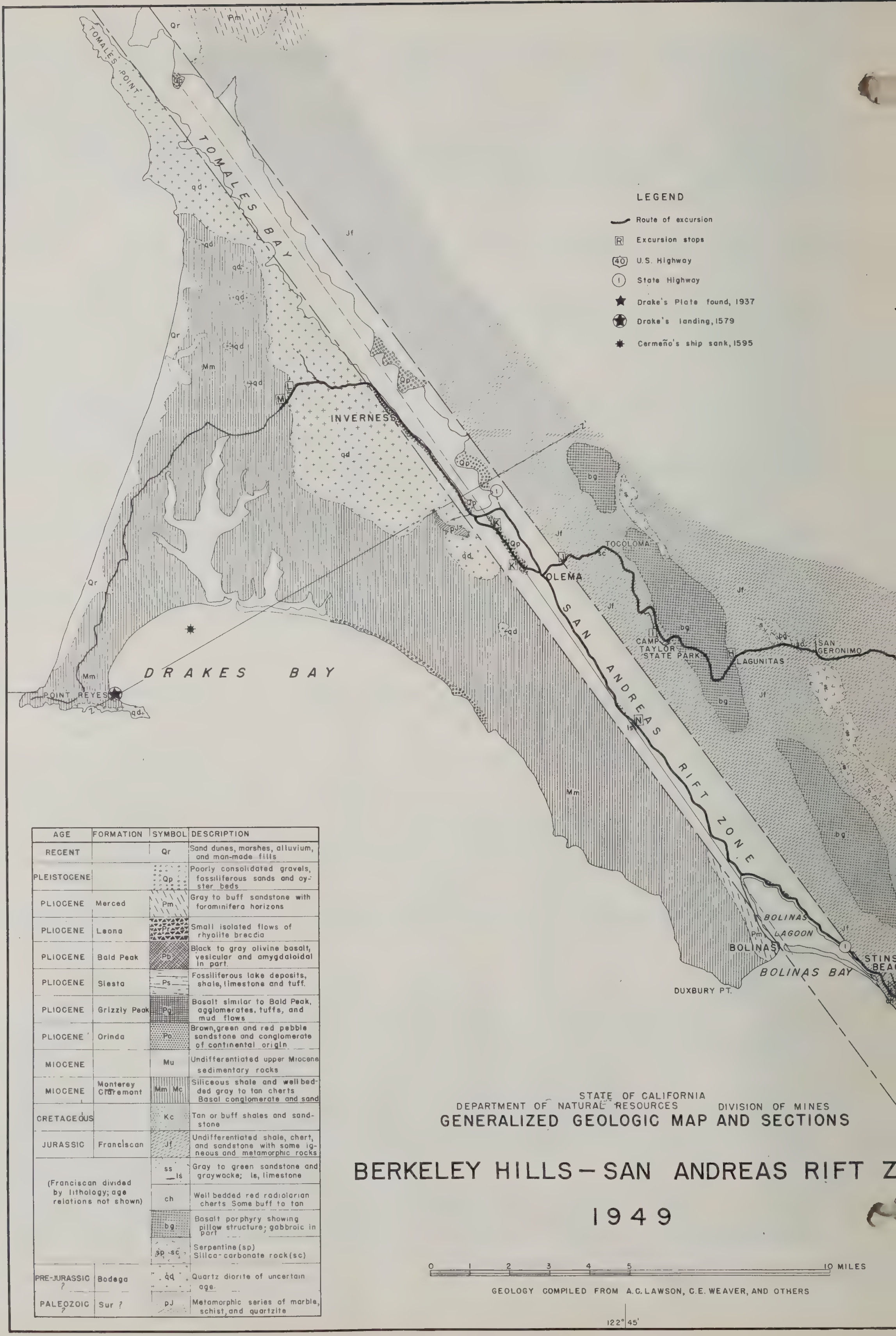
Caustic Soda - Caustic soda is what might be called a secondary pulping chemical. It is used in the preparation of purified cellulose for rayon pulps. Also, in the multi-stage bleaching of sulphate pulps it is finding wide application for removal of chlorinated products in the primary stages.

Annual consumption is about 110,000 tons, about six percent of the total. Based upon bleached pulp production, approximately 30,000 tons are required in this area.

Chlorine - In one form or another, chlorine finds application in most bleaching processes. This process, which we might term one of secondary cooking, accomplishes the final preparation of the pulp as a raw material for the paper mill. With the very rapid increase in production of bleached pulp, chlorine is very important in the industry. Approximately 250,000 tons or thirty percent of the total production is so used. The Pacific Coast requires 50,000 tons.

Fillers and Coating Materials - Many different pigments are used, both natural minerals and manufactured chemicals, to achieve the desired opacity, printability, color, smoothness and softness in the finished paper.

Clay is the most widely used pigment with its application being rapidly extended. At present around 600,000 tons, sixty percent of total production, are consumed annually. The Pacific Coast has not until very recently used an appreciable amount of this pigment.


TOMALES POINT
TOMALES BAY
INVERNESS
OLEMA
TOCOLOMA
CAMP TAYLOR STATE PARK
LAGUNITAS
SAN GERONIMO
SAN ANDREAS RIFT ZONE
DRAKES BAY
POINT REYES
BOLINAS LAGOON
BOLINAS
BOLINAS BAY
DUXBURY PT.
STINS
BEA
Qr
Qp
Pm
qd
Mm
Jf
bg
sc
ls
pJ
K
L
M
N
122° 45'

LEGEND

— Route of excursion

R Excursion stops

40 U.S. Highway

① State Highway

★ Drake's Plate found, 1937

✪ Drake's landing, 1579

✸ Cermeño's ship sank, 1595

AGE	FORMATION	SYMBOL	DESCRIPTION
RECENT		Qr	Sand dunes, marshes, alluvium, and man-made fills
PLEISTOCENE		Qp	Poorly consolidated gravels, fossiliferous sands and oyster beds
PLIOCENE	Merced	Pm	Gray to buff sandstone with foraminifera horizons
PLIOCENE	Leona	Pr	Small isolated flows of rhyolite breccia
PLIOCENE	Bald Peak	Pb	Black to gray olivine basalt, vesicular and amygdaloidal in part.
PLIOCENE	Siesta	Ps	Fossiliferous lake deposits, shale, limestone and tuff.
PLIOCENE	Grizzly Peak	Pg	Basalt similar to Bald Peak, agglomerates, tuffs, and mud flows
PLIOCENE	Orinda	Po	Brown, green and red pebble sandstone and conglomerate of continental origin
MIOCENE		Mu	Undifferentiated upper Miocene sedimentary rocks
MIOCENE	Monterey Claremont	Mm Mc	Siliceous shale and well bedded gray to tan cherts Basal conglomerate and sand
CRETACEOUS		Kc	Tan or buff shales and sandstone
JURASSIC	Franciscan	Jf	Undifferentiated shale, chert, and sandstone with some igneous and metamorphic rocks
(Franciscan divided by lithology; age relations not shown)		ss ls	Gray to green sandstone and graywacke; ls, limestone
		ch	Well bedded red radiolarian cherts Some buff to tan
		bg	Basalt porphyry showing pillow structure; gabbroic in part
		sp sc	Serpentine (sp) Silica-carbonate rock (sc)
PRE-JURASSIC ?	Bodega	qd	Quartz diorite of uncertain age.
PALEOZOIC ?	Sur ?	pJ	Metamorphic series of marble, schist, and quartzite

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES DIVISION OF MINES

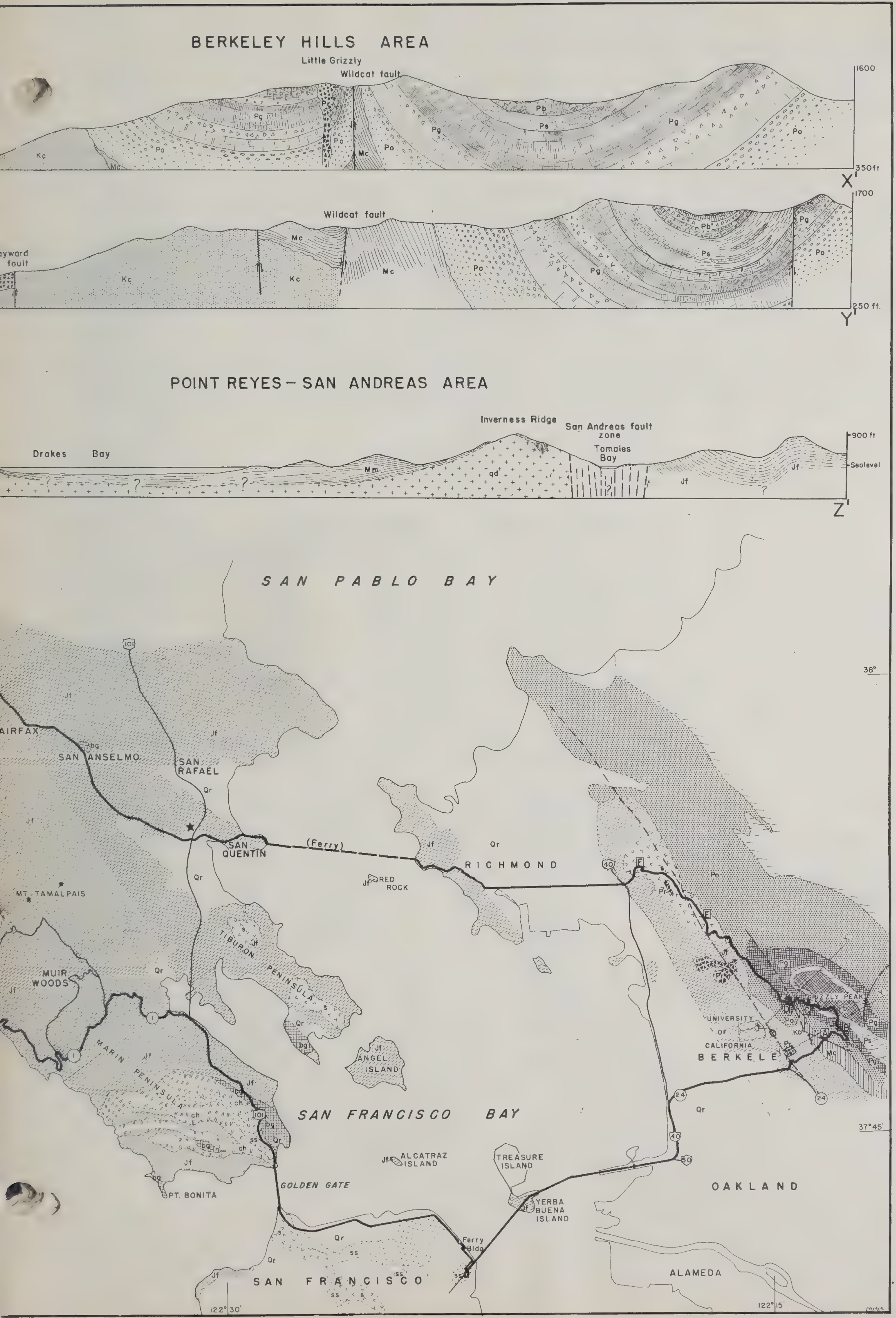
GENERALIZED GEOLOGIC MAP AND SECTIONS

BERKELEY HILLS — SAN ANDREAS RIFT Z

1949

0 1 2 3 4 5 10 MILES

GEOLOGY COMPILED FROM A.C. LAWSON, C.E. WEAVER, AND OTHERS


BERKELEY HILLS AREA
Little Grizzly
Wildcat fault
Kc
Mc
Po
Pg
Ps
Pb
1600
350 ft
X'
yward
fault
Wildcat fault
1700
250 ft.
Y'
POINT REYES — SAN ANDREAS AREA
Inverness Ridge
San Andreas fault zone
Tomales Bay
Drakes Bay
Mm
qd
Jf
900 ft
Sealevel
Z'
SAN PABLO BAY
101
AIRFAX
SAN ANSELMO
bg
SAN RAFAEL
Qr
SAN QUENTIN
(Ferry)
RICHMOND
RED ROCK
MT. TAMALPAIS
TIBURON PENINSULA
MUIR WOODS
1
MARIN PENINSULA
ch
ss
ANGEL ISLAND
SAN FRANCISCO BAY
ALCATRAZ ISLAND
TREASURE ISLAND
YERBA BUENA ISLAND
GOLDEN GATE
PT. BONITA
Ferry Bldg
SAN FRANCISCO
OAKLAND
ALAMEDA
40
50
24
F
E
D
C
B
A
Pr
GRIZZLY PEAK
UNIVERSITY OF CALIFORNIA
BERKELE
Y
38°
37°45'
122°30'
122°15'

Titanium dioxide finds application as the opacifying pigment in waxed papers. Its high refractive index makes it especially suitable for this purpose. Titanium dioxide is extended with barium and calcium sulphates for some uses. It is estimated that perhaps 30,000 tons of such pigments are required annually.

Other fillers which are used for special purposes are talc, calcium carbonate, zinc sulphide and oxide, lithopone, blanc fixe, and diatomaceous earth.

Clay - This paper has shown that clay is a very important material in the production of paper. England has always been the source of high quality china clay. However, for most purposes, the deposits in Georgia have been developed for satisfactory application. There are extensive clay deposits in the West, characterized by low color and considerable overburden. Whether or not a material acceptable to the paper industry could be produced presents a challenge. It would not necessarily be required that the clay be competitive to those now used. For many discussed and contemplated applications, lower brightness would be acceptable.

If one is conversant with papermaking literature, he has periodically read of the production of alum from clay. This is a proven possibility, economics being the primary consideration. At present, relatively high grade bauxite from the South is used.

TABLE II

Annual Production of Materials Used in the Paper Industry

	United States	Pacific Coast	
	Tons	Tons	% of U.S. Tons
Pulp	10,605,000	1,754,000	17-1/2
Sulphate	4,597,000	414,000	9
Sulphite	2,476,000	966,000	39
Mechanical	1,812,000	312,000	17
Soda	466,000	21,000	4-1/2
Others	1,254,000	- - - -	-
Paper	19,180,000	1,565,000	7-1/2
Board	8,450,000	450,000	5

Chemicals	Used in U.S. Pulp & Paper Industry-Tons	Used in Pacific Coast Pulp & Paper Industry - Tons	
Sulphur	400,000	145,000	(imported)
Limestone	440,000	173,000	(local)
Lime	500,000	50,000	(local)
Salt Cake	650,000	60,000	(local)
Soda Ash	150,000	10,000	(local)
Caustic Soda	110,000	30,000	(local)
Chlorine	250,000	50,000	(local)
Alum	150,000	15,000	(local)
Clay	600,000	30,000	(imported)
Titanium pigments	30,000	-	(imported)
Talc	30,000	-	(local)
Sodium Silicate	400,000	-	(local)
Calcium Carbonate	75,000	-	(imported)
Sulphuric Acid	9,000	-	(local)
Asphalt	-	7,000	(local)
Sodium Aluminate	5,000	-	(imported)

MINERAL PRODUCTION OF CALIFORNIA IN 1947, BY COUNTIES

The following figures are furnished by the U.S. Bureau of Mines in cooperation with the California Division of Mines.

County	Value	County	Value
Alameda	$8,497,176	Riverside	$8,381,215
Alpine	(1)	Sacramento	14,103,144
Amador	913,189	San Benito	2,497,069
Butte	1,311,410	San Bernardino	36,699,909
Calaveras	4,199,321	San Diego	1,882,394
Colusa	89,963	San Francisco	(3)
Contra Costa	1,388,682	San Joaquin	2,932,420
Del Norte	322,156	San Luis Obispo	396,393
El Dorado	1,641,020	San Mateo	5,334,024
Fresno	89,342,311	Santa Barbara	40,544,339
Glenn	2/ 383,043	Santa Clara	11,981,146
Humboldt	316,364	Santa Cruz	3,216,500
Imperial	907,843	Shasta	2,271,226
Inyo	6,596,468	Sierra	468,196
Kern	208,445,916	Siskiyou	1,170,971
Kings	24,601,000	Solano	8,302,751
Lake	107,232	Sonoma	1,050,051
Lassen	71,828	Stanislaus	1,112,357
Los Angeles	202,764,633	Sutter	110,789
Madera	237,072	Tehama	(2)
Marin	461,179	Trinity	561,555
Mariposa	301,938	Tulare	1,500,551
Mendocino	3/ 528,181	Tuolumne	901,067
Merced	742,366	Ventura	62,514,862
Modoc	116,170	Yolo	261,428
Mono	332,893	Yuba	2,559,132
Monterey	2,602,297		
Napa	359,911	Heavy clay products (not entirely separable by counties 4/----------	15,605,828
Nevada	1/ 3,008,304		
Orange	67,854,831		
Placer	487,751		
Plumas	261,100	State total (rounded)	855,553,000

1/ Output of Alpine County is included with Nevada County.
2/ Output of Tehama County is included with Glenn County.
3/ Output of San Francisco County is included with Mendocino County.
4/ Figure shown represents value of heavy clay products (other than pottery and refractories) as reported by U.S. Bureau of the Census ($16,793,000), less value of raw clay sold or used for the manufacture of cement and heavy clay products ($1,187,172).

ALAMEDA

Product	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)----------	-------	1/ $1,165,000
Clay, raw-------------------------------	18,751 short tons	18,782
Salt (sodium chloride)----------------	540,943 short tons	3,046,907
Stone-----------------------------------	1,112,500 short tons	714,025
Unapportioned (bromine, lime, crude magnesite, magnesium compounds, and sand and gravel)------------------	-------	4,717,462
Total value-----------------	-------	$8,497,176

ALPINE

The only commercial production in Alpine County in 1947 consisted of tungsten concentrates.

AMADOR

Product	Quantity	Value
Clay, raw	198,264 short tons	$380,496
Copper	1,674,000 pounds	351,540
Gold	4,724 troy ozs.	165,340
Silver	11,598 troy ozs.	10,496
Unapportioned (pumice, sand and gravel, and stone)	-------	5,317
Total value	-------	$913,189

BUTTE

Chromite	308 short tons	(2)
Gold	27,037 troy ozs.	$946,295
Sand and gravel	55,643 short tons	57,123
Silver	2,201 troy ozs.	1,992
Unapportioned (chromite, natural gas, crude platinum metals, and stone)	-------	306,000
Total value	-------	$1,311,410

CALAVERAS

Copper	1,242,000 pounds	$260,820
Gold	5,171 troy ozs.	180,985
Lead	90 short tons	25,920
Silver	97,076 troy ozs.	87,854
Zinc	2,350 short tons	568,700
Unapportioned (cement, raw clay, pumice, sand and gravel, and stone)	-------	3,075,042
Total value	-------	$4,199,321

COLUSA

Gold	6 troy ozs.	$210
Sand and gravel	225,729 short tons	89,750
Silver	3 troy ozs.	3
Total value	-------	$89,963

CONTRA COSTA

Clay products, heavy clay (other than pottery and refractories)	-------	(3)
Sand and gravel	378,734 short tons	$248,403
Stone	472,020 short tons	509,546
Unapportioned (raw clay, natural gas, and pumice)	-------	630,733
Total value	-------	$1,388,682

DEL NORTE

Chromite	640 short tons	(2)
Sand and gravel	55,017 short tons	(2)
Unapportioned (chromite, sand and gravel and stone)	-------	$322,156
Total value	-------	$322,156

EL DORADO

Product	Quantity	Value
Copper	112,000 pounds	$23,520
Gold	2,994 troy ozs.	104,790
Lead	2 short tons	576
Silver	2,039 troy ozs.	1,845
Stone	211,780 short tons	483,991
Zinc	6 short tons	1,452
Unapportioned (lime, sand and gravel, slate and soapstone)	------	1,024,846
Total value	------	$1,641,020

FRESNO

Clay products, heavy clay (other than pottery and refractories)	------	(3)
Gold	235 troy ozs.	$8,225
Natural gas	63,814,000 M cu. ft.	6,750,000
Natural gasoline and allied products:		
Natural gasoline	75,836,000 gallons	3,948,000
Liquefied petroleum gases	41,690,000 gallons	1,699,000
Petroleum	44,133,000 barrels	75,388,000
Sand and gravel	1,031,322 short tons	1,141,346
Silver	37 troy ozs.	33
Stone	164,910 short tons	292,835
Unapportioned (raw clay, crude feldspar crude gypsum, mercury, pumice, and tungsten concentrates)	------	114,872
Total value	------	$89,342,311

GLENN

Production in Glenn County in 1947 consisted of natural gas and sand and gravel.

HUMBOLDT

Clay products, heavy clay (other than pottery and refractories)	------	(3)
Gold	139 troy ozs.	$4,865
Sand and gravel	261,063 short tons	221,278
Silver	22 troy ozs.	20
Stone	60,120 short tons	(2)
Unapportioned (raw clay, natural gas, and stone)	------	90,201
Total value	------	$316,364

IMPERIAL

Sand and gravel	232,704 short tons	(2)
Unapportioned (crude gypsum, scrap mica and sand and gravel)	------	$907,843
Total value	------	$907,843

INYO

Copper	232,000 pounds	$48,720
Gold	1,974 troy ozs.	69,090
Lead	8,990 short tons	2,589,120
Silver	1,235,998 troy ozs.	1,118,578
Stone	69,320 short tons	118,471
Sulfur ore	698 long tons	9,074

INYO (Cont.)

Product	Quantity	Value
Talc and pyrophyllite	30,444 short tons	482,007
Zinc	702 short tons	169,884
Unapportioned (boron minerals, raw clay, diatomite, fuller's earth, molybdenum, pumice, sand and gravel, sodium salts, and tungsten concentrates)	------	1,991,524
Total value	------	$6,596,468

KERN

Product	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)	------	(3)
Clay, raw	213,475 short tons	$746,372
Gold	6,228 troy ozs.	217,980
Gypsum, crude	4/ 352,977 short tons	4/ 558,269
Natural gas	86,289,000 M cu. ft.	8,329,000
Natural gasoline and allied products:		
Natural gasoline	135,140,000 gallons	6,766,000
Liquefied petroleum gases	91,600,000 gallons	3,571,000
Petroleum	106,048,000 barrels	176,360,000
Sand and gravel	608,674 short tons	671,917
Silver	7,686 troy ozs.	6,956
Unapportioned (boron minerals, cement, pumice, salt, silica (quartz), stone, and tungsten concentrates)	------	11,218,422
Total value	------	$208,445,916

KINGS

Product	Quantity	Value
Gypsum, crude	(4)	(4)
Natural gas	39,972,000 M cu. ft.	$4,282,000
Natural gasoline and allied products:		
Natural gasoline	63,827,000 gallons	3,475,000
Liquefied petroleum gases	36,986,000 gallons	1,362,000
Petroleum	7,503,000 barrels	15,482,000
Total value	------	$24,601,000

LAKE

Product	Quantity	Value
Mercury	364 flasks	(2)
Sand and gravel	70,284 short tons	(2)
Unapportioned (mercury, sand and gravel, and stone)	------	$107,232
Total value	------	$107,232

LASSEN

Production in Lassen County in 1947 consisted of gold, sand and gravel, silver, and stone.

LOS ANGELES

Product	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)	------	1/ $10,936,000
Clay, raw	477,011 short tons	436,146
Gold	48 troy ozs.	1,680
Natural gas	95,702,000 M cu. ft.	8,348,000
Natural gasoline and allied products:		
Natural gasoline	300,722,000 gallons	15,928,000
Liquefied petroleum gases	16,238,000 gallons	508,000
Petroleum	91,889,000 barrels	164,122,000
Sand and gravel	11,088,519 short tons	6,866,923

LOS ANGELES (Cont.)

Product	Quantity	Value
Silver	6 troy ozs.	5
Stone	4,284,150 short tons	3,167,650
Unapportioned (cement, diatomite, iodine, lime, silica (quartz), and soapstone)	------	3,386,229
Total value	------	$202,764,633

MADERA

Gold	197 troy ozs.	$6,895
Pumice	17,080 short tons	(2)
Silver	57 troy ozs.	52
Unapportioned (natural gas, pumice, stone, and tungsten concentrates)	------	230,125
Total value	------	$237,072

MARIN

Production in Marin County in 1947 consisted of raw clay, sand and gravel, and stone.

MARIPOSA

Copper	4,000 pounds	$840
Gold	6,363 troy ozs.	222,705
Silver	1,933 troy ozs.	1,749
Unapportioned (barite, sand and gravel, and stone)	------	76,644
Total value	------	$301,938

MENDOCINO

The only production in Mendocino County in 1947 consisted of sand and gravel.

MERCED

Production in Merced County in 1947 consisted of gold, crude platinum metals, sand and gravel, and silver.

MODOC

Sand and gravel	198,513 short tons	(2)
Stone	79,180 short tons	(2)
Unapportioned (pumice, sand and gravel, and stone)	------	$116,170
Total value	------	$116,170

MONO

Copper	18,000 pounds	$3,780
Gold	41 troy ozs.	1,435
Lead	17 short tons	4,896
Pumice	4,738 short tons	220,088
Silver	7,323 troy ozs.	6,627
Unapportioned (pyrophyllite, sand and gravel, stone, and tungsten concentrates)	------	96,067
Total value	------	$332,893

MONTEREY

Product	Quantity	Value
Sand and gravel	646,973 short tons	$1,022,058
Stone	147,730 short tons	232,980
Unapportioned (lime, magnesium compounds, petroleum, salt, sand and sandstone (ground)	------	1,347,259
Total value	------	2,602,297

NAPA

Stone	161,440 short tons	$202,386
Unapportioned (mercury, pumice, and sand and gravel)	------	157,525
Total value	------	$359,911

NEVADA

Production of Nevada County in 1947 consisted of gold, silver, and stone.

ORANGE

Clay products, heavy clay (other than pottery and refractories)	------	(3)
Clay, raw	20,437 short tons	$72,520
Natural gas	29,399,000 M cu. ft.	2,465,000
Natural gasoline and allied products:		
Natural gasoline	115,423,000 gallons	5,911,000
Liquefied petroleum gases	4,528,000 gallons	150,000
Petroleum	34,146,000 barrels	58,274,000
Sand and gravel	961,207 short tons	812,831
Unapportioned (peat, salt, and stone)	------	169,480
Total value	------	$67,854,831

PLACER

Clay products, heavy clay (other than pottery and refractories)	------	(3)
Gold	5,358 troy ozs.	$187,530
Silver	807 troy ozs.	730
Stone	100,410 short tons	81,976
Unapportioned (asbestos, raw clay, sand and gravel, and slate)	------	217,515
Total value	------	$487,751

PLUMAS

Copper	28,000 pounds	$5,880
Gold	546 troy ozs.	19,110
Silver	570 troy ozs.	516
Stone	201,480 short tons	(2)
Unapportioned (barite, sand and gravel and stone)	------	235,594
Total value	------	$261,100

RIVERSIDE

Clay products, heavy clay (other than pottery and refractories)	------	(3)
Clay, raw	283,177 short tons	(2)
Gold	30 troy ozs.	$1,050

RIVERSIDE (Cont.)

Product	Quantity	Value
Iron ore	27,029 long tons	(2)
Sand and gravel	472,839 short tons	517,871
Silver	15 troy ozs.	14
Stone	138,250 short tons	156,700
Unapportioned (cement, raw clay, crude gypsum, and iron ore)	-------	7,705,580
Total value	-------	$8,381,215

SACRAMENTO

Clay products, heavy clay (other than pottery and refractories)	-------	1/ $340,000
Clay, raw	30,619 short tons	(2)
Gold	113,560 troy ozs.	3,974,600
Natural gas	72,883,000 M cu. ft.	8,357,000
Sand and gravel	1,564,464 short tons	1,334,108
Silver	6,203 troy ozs.	5,614
Stone	269,400 short tons	375,438
Unapportioned	-------	56,384
Total value	-------	$14,103,144

SAN BENITO

Mercury	9,228 flasks	$772,753
Stone	1,013,980 short tons	(2)
Unapportioned (cement, raw clay, sand and gravel, and stone)	-------	1,724,316
Total value	-------	$2,497,069

SAN BERNARDINO

Calcium-magnesium chloride	7,968 short tons	$111,950
Clay, raw	63,491 short tons	232,206
Coke	332,244 short tons	(5)
Copper	92,000 pounds	19,320
Gold	4,409 troy ozs.	154,315
Iron: Ore	346,545 long tons	(2)
Pig	453,376 short tons	(5)
Lead	158 short tons	45,504
Lime	31,457 short tons	328,329
Salt (sodium chloride)	150,293 short tons	386,742
Sand and gravel	1,151,258 short tons	1,124,251
Silver	103,877 troy ozs.	94,009
Stone	558,580 short tons	827,992
Talc	46,535 short tons	997,446
Zinc	650 short tons	157,300
Unapportioned (boron minerals, bromine, cement, iron ore, lithium minerals, petroleum, potassium salts, silica (quartz) sodium salts, and tungsten concentrates)	-------	32,220,545
Total value	-------	$36,699,909

SAN DIEGO

Clay products, heavy clay (other than pottery and refractories)	-------	(1)
Clay, raw	14,533 short tons	$15,005
Gold	13 troy ozs.	455
Sand and gravel	1,195,011 short tons	1,324,830

SAN DIEGO (Cont.)

Product	Quantity	Value
Silver	6 troy ozs.	5
Stone	79,410 short tons	196,037
Unapportioned (magnesium compounds, pebbles for grinding, pyrophyllite, and salt)	-------	346,062
Total value	-------	$1,882,394

SAN FRANCISCO

Production in San Francisco County in 1947 consisted of heavy clay products, gold, and stone.

SAN JOAQUIN

Product	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)	-------	1/ $291,000
Natural gas	9,650,000 M cu. ft.	1,261,000
Sand and gravel	1,598,607 short tons	1,330,544
Unapportioned (raw clay, gold, silver, and stone)	-------	340,876
Total value	-------	$2,932,420

SAN LUIS OBISPO

Product	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)	-------	(3)
Mercury	449 flasks	$37,599
Unapportioned (raw clay, petroleum, sand and gravel, and stone)	-------	358,794
Total value	-------	$396,393

SAN MATEO

Product	Quantity	Value
Stone	1,078,700 short tons	$1,184,602
Unapportioned (cement, magnesium compounds, and sand and gravel)	-------	4,149,422
Total value	-------	$5,334,024

SANTA BARBARA

Product	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)	-------	(3)
Natural gas	18,070,000 M cu. ft.	$1,317,000
Natural gasoline and allied products:		
Natural gasoline	36,225,000 gallons	1,861,000
Liquefied petroleum gases	1,542,000 gallons	53,000
Petroleum	22,463,000 barrels	33,221,000
Sand and gravel	198,897 short tons	(2)
Stone	379,890 short tons	(2)
Unapportioned (raw clay, diatomite, sand and gravel, and stone)	-------	4,092,339
Total value	-------	$40,544,339

SANTA CLARA

Product	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)	-------	1/ $1,201,000
Clay, raw	158,206 short tons	(2)
Ferro-alloys	5,278 short tons	(5)
Mercury	586 flasks	49,072
Sand and gravel	352,266 short tons	(2)

SANTA CLARA (Cont.)

Product	Quantity	Value
Stone	400,080 short tons	462,732
Unapportioned (cement, raw clay, petroleum, sand and gravel and silica (quartz)	-------	11,469,342
Total value	-------	$11,981,146

SANTA CRUZ

Product	Quantity	Value
Stone	27,280 short tons	$134,127
Unapportioned (asphalt, cement, raw clay, lime, peat, and sand and gravel)	-------	3,082,373
Total value	-------	$3,216,500

SHASTA

Product	Quantity	Value
Copper	1,396,000 pounds	$293,160
Lead	817 short tons	235,296
Sand and gravel	258,960 short tons	224,273
Zinc	1,707 short tons	413,094
Unapportioned (asbestos, gold, pyrites, silver, and stone)	-------	1,105,403
Total value	-------	$2,271,226

SIERRA

Product	Quantity	Value
Gold	13,263 troy ozs.	$464,205
Lead	6 short tons	1,728
Silver	2,501 troy ozs.	2,263
Total value	-------	$468,196

SISKIYOU

Product	Quantity	Value
Pumice	19,965 short tons	$143,963
Stone	188,970 short tons	149,679
Unapportioned (diatomite, gold, sand and gravel and silver)	-------	877,329
Total value	-------	$1,170,971

SOLANO

Product	Quantity	Value
Natural gas	65,411,000 M cu. ft.	$8,155,000
Unapportioned (sand and gravel and stone)	-------	147,751
Total value	-------	$8,302,751

SONOMA

Product	Quantity	Value
Mercury	4,247 flasks	$355,644
Sand and gravel	584,044 short tons	515,340
Stone	141,370 short tons	(2)
Unapportioned (pumice and stone)	-------	179,067
Total value	-------	$1,050,051

STANISLAUS

Product	Quantity	Value
Sand and gravel	392,090 short tons	$439,054
Unapportioned (raw clay, gold, natural gas, silver and stone)	-------	673,303
Total value	-------	$1,112,357

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SUTTER

Production in Sutter County in 1947 consisted of raw clay, natural gas, and sand and gravel.

TEHAMA

Production in Tehama County in 1947 consisted of sand and gravel and stone.

TRINITY

Product	Quantity	Value
Gold	13,905 troy ozs.	$486,675
Unapportioned (copper, sand and gravel, silver, and stone)	------	74,880
Total value	------	$561,555

TULARE

Product	Quantity	Value
Stone	92,040 short tons	$132,457
Unapportioned (natural gas, sand and gravel, and tungsten concentrates)	------	1,368,094
Total value	------	$1,500,551

TUOLUMNE

Product	Quantity	Value
Copper	12,000 pounds	$2,520
Gold	4,232 troy ozs.	148,120
Silver	2,015 troy ozs.	1,824
Stone	43,330 short tons	252,189
Unapportioned (lime, sand and gravel, and talc)	------	496,414
Total value	------	$901,067

VENTURA

Product	Quantity	Value
Natural gas	46,140,000 M cu. ft.	$4,392,000
Natural gasoline and allied products:		
Natural gasoline	110,140,000 gallons	7,923,000
Liquefied petroleum gases	40,962,000 gallons	831,000
Petroleum	26.858,000 barrels	48,750,000
Sand and gravel	676,173 short tons	(2)
Unapportioned (raw clay, sand and gravel, and stone)	------	618,862
Total value	------	$62,514,862

YOLO

Product	Quantity	Value
Sand and gravel	167,650 short tons	$70,276
Unapportioned (mercury, natural gas, and stone)	------	191,152
Total value	------	$261,428

YUBA

Production in Yuba County in 1947 consisted of gold, crude platinum metals, sand and gravel and silver.

1/ According to U.S. Bureau of the Census. Value not included in County total. 2/ Value included with "Unapportioned." 3/ U.S. Bureau of the Census not at liberty to publish figure. Value not included in county total. 4/ A small quantity of crude gypsum produced in Kings County is included with Kern County. 5/ Bureau of Mines not at liberty to publish figure. Value not included in County and State totals.

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DEPARTMENT OF NATURAL RESOURCES
WARREN T. HANNUM, Director

DIVISION OF MINES
Ferry Building, San Francisco 11
OLAF P. JENKINS, Chief

MINERAL INFORMATION SERVICE

Vol. 2. March 1, 1949 No. 3

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

MINING AND INDUSTRIAL NEWS NOTES

Trinity County Dragline Dredge Operation

Dredging equipment is being moved from Indian Creek near Douglas City to Buckeye Creek west of Stringtown, all in Trinity County. The ground along Buckeye Creek is 9-12 feet deep and consists of gravel, cobbles, and boulders lying on soft, decomposed, granitic bedrock. The channel is 150 feet wide and extends for three miles along the creek. The dredging equipment consists of the following items:

1. A Lima 602 dragline having a 57-foot boom and a 2-cu. yd. capacity bucket.
2. A Bodinson-built washing plant built on five steel pontoons which form a barge 36 feet x 46 feet x 42 inches deep. The trommel is 5 feet in diameter and 44 feet long. Water is supplied by a Fairbanks-Morse 10-inch centrifugal pump. The stacker belt is 30 inches wide and 50 feet long between pulleys.

The dredge will be operated by V.B. Bennett of Sacramento, and a crew of fifteen men will be employed.

NEW PUBLICATIONS OF THE DIVISION OF MINES

1948 Issue of the California Journal of Mines and Geology

A limited number of cloth-bound copies of California Journal of Mines and Geology for the year 1948 (volume 44) are now available.

This volume, bound in black cloth, with gold lettering, and priced at $4.00, contains the following material:

January 1948 Journal, which includes: Trends in the Foundry-Sand Industry, by Leonard O. Hofstetter; Properties of Foundry Sands, by Heinrich Ries; California Foundry Sands, by Lauren A. Wright; Uranium, by W.B. Winston; Manner of Locating and Holding Mineral Claims in California, by A.H. Ricketts, revised by C.A. Logan.

April 1948 Journal, which includes: The Basement Complex in Well Samples from the Sacramento and San Joaquin Valleys, by J.C. May and R.L. Hewitt; Mines and Mineral Resources of Napa County, California, by Fenelon F. Davis; Soda Ash and Saltcake in California, by Clarence R. King; The Lakes of California, by William Morris Davis.

July 1948 Journal, which includes: Unusual Concretions from Templeton, San Luis Obispo County, California, by R.A. Crippen; Quicksilver Deposits of the Guerneville District, Sonoma County, California, by W. Bradley Myers and Donald L. Everhart; Mining Law in Recent Years, by William E. Colby; Pumice and Perlite as Industrial Materials in California, by C.R. King.

October 1948 Journal, which includes: Economic Aspects of Mercury Production in California, by Clarence R. King; Current and Recent Mining Activities in the Redding District, by J.C. O'Brien; The Spectrograph and Polarograph, by John Herman; Public Resources Code; U.S. Atomic Energy Commission Announces Program to Stimulate Production of Domestic Uranium; Publications of the California State Division of Mines, Index to Volume 44.

California Journal of Mines and Geology

The January 1949 issue of the California Journal of Mines and Geology is now ready for distribution. This issue contains the "Annual Report, Division of Mines, for the Ninety-Ninth Fiscal Year", by Olaf P. Jenkins, an important statistical summary giving the activities of the Division of Mines and brief mineral production figures for the year 1946-47.

"Quicksilver Deposits of the Oakville District, Napa County, California", by Philip F. Fix and C. Melvin Swinney, both geologists of the U.S. Geological Survey, concerns one of California's most strategic minerals and discusses its abundance and the methods of mining it in the Oakville district. As California is one of the largest quicksilver producers in the United States, this paper is especially interesting.

To bring up to date the record of mining in Tuolumne County since our last report in 1928, Clarence A. Logan has written a paper on the "Mines and Mineral Resources of Tuolumne County, California". In common with most of the counties along the eastern slope of the Sierra Nevada, Tuolumne contains deposits of chromite, copper, soapstone, scheelite, and slate. It also has notable resources of limestone.

W.B. Winston's paper on "Barium" gives the reader an idea of its history, uses, properties, preparation, locations, and mode of occurrence. Barium is a common gangue mineral in vein deposits, particularly those in the silver-lead districts. Its largest use in the United States is in the manufacture of lithopone, one of the principal constituents of "flat" wall paints. Other important uses are as an inert pigment and filler in paint, paper, linoleums, oilcloth, and rubber manufacture, in the preparation of many chemicals, and in heavy-gravity oil-well drilling-mud fillers. It is found in many places in California principally in Inyo, Los Angeles, Mariposa, Monterey, Nevada, Plumas, San Bernardino, Shasta, Santa Barbara and Tulare Counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date.

"The Penn Mine Slag Dump and Mine Water, Calaveras County, California," by Frank J. Wiebelt and Spangler Ricker is a reprint of Information Circular 4224 which summarizes work done by the Bureau of Mines with the object of the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy.

A list of map symbols used by the U.S. Geological Survey is also included. Although this list has been prepared primarily for use in publications of the Geological Survey, it is hoped that it will be helpful to all geologists and will eventually bring about a general uniformity of usage.

Single issues of the Journal sell for 75¢ each; yearly subscriptions are $2.50.

Second Printing of Bulletin 141

The second printing of Bulletin 141, The Mother Lode Country - Geologic Guidebook Along Highway 49, is now in press and is expected to be ready for distribution about March 1. Few publications of the Division have received such rapid and widespread response from the public. The first edition of 7500 copies was exhausted within 2½ months of the initial distribution date. The second edition will consist of 10,000 copies. Although primarily a publication for California, widespread out-of-state interest is reflected in the mailing list.

Orders for copies of the new edition are now being taken. These will remain at the established price of $1.00 each. California residents please add 2½ percent sales tax to their remittances.

ALPINE COUNTY

General Geologic Features

Alpine County, located along the eastern border of central California, a few miles south of Lake Tahoe, is an area of mountain peaks and ridges, cut by a few deep valleys. Maximum elevations are reached in the southeastern corner of the county where Stanislaus Peak and White Mountain stand over 11,000 feet above sea level.

The western part of the county is occupied almost entirely by the granitic rocks of the Sierra Nevada batholith, with the western boundary paralleling the northerly trending crest of California's dominant mountain range. The Jurassic intrusives of the Sierra Nevada in the eastern Sierra are strongly fissured and jointed in contrast to the granitic rocks of the western slopes (Lindgren, 1911). Glaciated rocks of the western part of the county are ample evidence of the numerous glaciers which occupied present drainage areas in late Pleistocene time (Blackwelder, 1932).

Tertiary volcanics, essentially andesite, blanket a large portion of the eastern half of Alpine County and extend into neighboring Nevada. A few isolated patches of these volcanics are found in the western half. Silicification of the volcanics and resulting mineral deposition is pronounced in several sections, particularly in the area southeast of Markleeville (Eakle, et al, 1916). A few small outcrops of pre-Cretaceous metamorphics, including slates, schists, limestone, greenstone, and conglomerate are widely scattered throughout the county. They are embedded in the granite or granodiorite and have suffered regional and contact metamorphism (Lindgren, 1911).

Drainage of this high Sierra country is mainly through the East Fork and West Fork of the Carson River and their many tributaries. The East Fork rises in the south central portion of the county and flows northward through the main volcanic rock area into Carson Valley. The West Fork rises in the west central part, flows northward, thence eastward into the adjoining state. Headwaters of the Stanislaus and Mokelumne Rivers drain the southwestern area.

Grover's Hot Springs are situated near the southern terminus of a major fault which strikes northward and passes near Woodfords. Numerous large hot springs are located along this fissure along its northerly extension in Nevada. Where the escarpment crosses the West Fork of the Carson River, the gradient of the stream increases markedly downstream.

Mineral Resources

In spite of the variety of mineral occurrences which have been reported in Alpine County, including copper, lead, zinc, gold, silver, quicksilver, molybdenum, tungsten, limestone, miscellaneous stone and sulphur, the production has been small. There are no important deposits of auriferous gravels. During the period of recorded production from 1880-1947, the total was less than $400,000. Prior to 1880 an estimated $1,000,000 in gold and silver was produced from the county. This period of productivity paralleled the Comstock Lode activity. Alpine County contributed heavily to the development of the Comstock Lode by furnishing mine timbers and fuel from its abundantly forested mountains.

The most important mineralized area of the county lies a few miles south and southeast of Markleeville, centering around the Mogul, Monitor, and Silver Mountain districts. Here the prominent andesite has been extremely altered and silicified by ascending thermal waters with the subsequent deposition of complex ores of gold, silver, lead, zinc, and copper. Sulphur in commercial quantities is found in the Leviathan mine, originally opened as a copper property, in the northeastern section of the mineralized area. The complex nature of the low grade ores made beneficiation difficult in the early days and contributed to the decline in production. Some high grade spots were encountered in the orebodies which are generally without definite walls, being impregnated masses of the altered andesite. No great depth was reached in the operations, a great deal of the prospecting and development work being done through adits.

In the Silver King district, 15 miles south of Monitor, auriferous pyrite occurs in a section of metamorphosed rocks (schists). Ten miles west of Markleeville, in the Blue Lakes and Hope Valley region, metamorphosed sediments have been mined for gold, silver, copper, and tungsten. The latter occur in the contact metamorphic orebodies (tactite) in limestone in the Hope Valley section. Epithermal hübnerite (manganese tungstate) has been found in the ore of the Zaca Mine (silver) near Monitor (Gianella, 1948).

Significant Activities of 1947

Mineral production in Alpine County during 1947 was confined to that from tungsten and miscellaneous stone (sand and gravel). The Alpine Mining Company (Wolframite mine) operated their tungsten deposit three miles north of Carson Pass in Hope Valley during the year. The ore was hauled to Minden, Nevada, for concentration. At the Leviathan mine (copper-sulphur), the Siskon Mining Company continued rehabilitation of the mine workings. There was no reported production of gold and silver for the year.

THE WESTERN PAINT AND VARNISH INDUSTRY AS A CONSUMER OF CHEMICALS

The following passages are excerpts from a paper presented by M.W. Reece and H.L. Wampner in "By Gum!", publication of Reichhold Chemicals, Inc., of Detroit, Michigan, branch at Linden Ave., South San Francisco.

Two methods were used to obtain our data - one was consulting the published information made available by government agencies and trade associations; the other was addressing letters to the principal suppliers of chemicals requesting their estimates of the amount of the specific chemicals involved used by west coast protective coating manufacturers during the three years - 1936, 1941 and 1946. Wherever possible, we obtained information on a specific chemical from as many suppliers as possible. These figures were then averaged to obtain the figures shown. Where reasonably accurate data were available on the volume of chemicals consumed by the western protective coating industry, these were checked against the national consumption to arrive at a percentage figure. Since the bulk of the accurate data on west coast consumption of various chemicals checks out with a high degree of uniformity on a percentage of national consumption basis, we were able to arrive at the following figures. In 1936, the western paint and varnish industry consumed approximately 8 percent of the total amount of chemicals consumed by the protective coating industry nationally. This figure in 1941 rose to 10 percent and in 1946, to approximately 12 percent.

It is interesting to note that the paint, varnish and lacquer industry in 1941 showed total sales 40 percent greater than in 1936 and the total in 1946 was 100 percent greater than 1936. Our own western protective coating industry has shown a steady advance in sales volume, and as compared to the national total, the western percentage increase has been greater.

Table 1 shows the consumption of white hiding, or opaque pigments. The interesting fact here is that the pigments on which our industry was built, namely lead carbonate, lead sulphate and zinc oxide, show very little change over this ten year period. However lithopone, titanium dioxide, extended titanium pigments and leaded zinc oxide, have shown large tonnage increases. The larger increase is shown in the period from 1936 to 1941 and a similar increase might well have been shown over the 1941-1946 period had it been possible. However, owing to limited production capacity and limited raw materials, the figures indicate the maximum that the industry was able to secure rather than the maximum it was able to consume. Another interesting fact is the increasing importance of titanium pigments in the protective coating industry. In the last twenty years these pigments have steadily increased in demand until today they account for nearly one-third of the white hiding pigment consumed. While lead and zinc volume has remained fairly constant, titanium pigments, along with lithopone and leaded zinc, have accounted for most of the white hiding pigment in the increased volume the industry has shown.

Table 1 - Consumption of white hiding pigments.

Chemical	Pounds Consumed 1936	1941	1946
Lead Carbonate (basic)	22,700,000	20,100,000	20,000,000
Lead Sulfate (basic)	1,620,000	1,900,000	2,000,000
Zinc Oxide	6,600,000	6,000,000	6,500,000
Lithopone	14,500,000	25,300,000	28,800,000
Titanium Dioxide	3,700,000	6,200,000	6,500,000
Extended Titanium Pigments	10,800,000	22,500,000	23,000,000
Leaded Zinc Oxide	8,000,000	13,500,000	13,500,000
Total Consumed (West Coast)	67,920,000	95,500,000	100,300,000

Table 2 shows the consumption of inorganic colored, or opaque, hiding pigments. With a few exceptions, the figures shown are self-explanatory. We might state that in the case of zinc chromate, there was practically no consumption in 1936 (about the time of its introduction as a priming pigment) yet this rose to within 75 percent of the red lead figure in 1946, which indicates its adoption by the industry as a volume chemical. Synthetic iron oxides have also made great inroad into the industry until today 70 percent of all earth colors used are synthetic iron oxides. Chromium oxide has become an important colored pigment - present volume being seven times greater than in 1936. The war years increased the use of chromium oxide decidedly because of its high infra-red reflectance, and it has continued in demand as an important colored pigment.

Table 2 - Consumption of colored hiding pigments (inorganic).

Chemical	Pounds Consumed 1936	1941	1946
Lead Chromate	3,900,000	4,200,000	5,000,000
Zinc Chromate	—	1,000,000	3,000,000
Hydrated Iron Oxide	6,400,000	9,000,000	12,000,000
Chrome Green	1,000,000	1,200,000	1,500,000
Chromium Oxide	120,000	200,000	750,000
Iron Blue	750,000	820,000	850,000
Ultramarine Blue	700,000	800,000	850,000
Blue Lead	170,000	140,000	150,000
Iron Oxide	1,000,000	1,500,000	2,750,000
Red Lead	2,400,000	4,000,000	4,000,000
Litharge	850,000	630,000	700,000
Blacks (Lamp & Carbon)	300,000	500,000	650,000
Earth Colors (other)	2,700,000	4,000,000	5,400,000
Total Consumed (West Coast)	20,290,000	27,990,000	37,600,000

Table 3 - Consumption of non-hiding or extender pigments.

Chemical	Pounds Consumed 1936	1941	1946
Talc	20,000,000	25,000,000	29,000,000
Barytes	4,000,000	5,000,000	6,000,000
China Clay	8,000,000	10,000,000	12,000,000
Whiting (calcium carbonate)	10,000,000	13,000,000	15,000,000
Silica	4,000,000	5,000,000	6,000,000
Total Consumed (West Coast)	46,000,000	58,000,000	68,000,000

Table 4 on volatile ingredients in protective coatings was more difficult to arrive at than any other because of the widely varying estimates on some of the items. An attempt was made, however, to correlate these data with others on volume production of finished products. The increased use of solvents therefore, follows the increase in coatings on the west coast. The really significant changes are not indicated by the data given here. Between 1941 and 1946 there has been the large development of high aromatic petroleum products here on the coast and even the production of such items as toluol and xylol from petroleum rather than from coal tar.

Another change which is not indicated is the large increase in ketone solvents and alcohols derived from petroleum between the years 1936 and 1946. Ester and alcohol solvents from non-petroleum sources in 1936 and 1941 probably increased somewhat and then decreased drastically by 1946. The overall increase in such solvents is therefore due primarily to the quantities supplied from petroleum or synthetic origin.

Table 4 – Consumption of solvents.

Chemical	Gallons Consumed 1936	1941	1946
Mineral Spriits & Thinners (incl. Aromatic Petroleum Hydrocarbons)	10,000,000	20,000,000	30,000,000
Turpentine	2,000,000	2,000,000	2,000,000
Coal Tar Solvents	750,000	1,500,000	2,000,000
Alcohols, Esters, Ketones	1,500,000	3,000,000	4,000,000
Total Consumed (West Coast)	14,250,000	26,500,000	38,000,000

The figures given in this paper are only estimates. We have attempted to assemble our data as accurately as possible, but inaccuracy and duplication are bound to result when material is reported from a number of sources. Only the important raw materials have been included and these have been confined to those chemicals where the tonnage was substantial. Hundreds of less important items used by the industry have not been mentioned since they have no great bearing on the western paint and varnish industry as a consumer of chemicals.

We have rechecked our figures with the men who are actually selling the various chemicals involved since these men are closer to the industry than perhaps any other group. Where the consensus was that the figures were high or low, they were adjusted accordingly.

We basically tried to include only materials as used by the industry rather than breaking these materials down to their component chemical parts. This, however, is a relatively simple matter since, in most cases, the chemical composition of these products is known.

We are extremely optimistic about the future of our industry on the west coast. The war years taught us much and wrought innumerable changes in our industry. In providing our great west coast shipbuilding and aircraft industries with every conceivable type of coating we made advances which will be reflected in years to come. A tremendous market lies ahead of us, one which will see in excess of $100,000,000 sales volume this year (1947) for the west coast alone and a national volume of close to $1,000,000,000.

We wish to acknowledge gratefully the help and cooperation of the companies and individuals who made this paper possible through their assistance in furnishing data on chemical consumption. The list includes nearly all of the suppliers of raw materials to the protective coating industry on the coast.

Most figures in the charts are rounded off since many are based on a percentage of the national total. Sources were U.S. Bureau of Census, Census of Manufacturers, Current Statistical Service, and various individual reports, U.S. Tariff Commission, U.S. Bureau of Mines, U.S. Department of Agriculture, estimates by producers and average estimates of west coast suppliers, trade association reports, and informed individual opinion.

BISMUTH

Bismuth is a coarsely crystalline metallic element with a high luster and a reddish-tinged, tin-white color and streak, both of which are subject to an iridescent tarnish. Its hardness is 2 to 2.5, its specific gravity is 9.8, it crystallizes in the rhombohedral class of the hexagonal system, and is generally reticulated or arborescent in form (sometimes foliated or granular). The cleavage is perfect and the metal is both sectile and somewhat malleable when heated. Bismuth is rather widely distributed but cannot be considered abundant. It occurs as native metal or as an oxide, bismite; the carbonate, bismutite, or as the sulphide, bismuthenite. Bismuth is also a constituent of many complex minerals, and when it is found in a metalliferous vein associated with silver, copper, or lead, it is usually combined with those metals as a sulpho-salt.

Bismite, Bi_2O_3, sometimes called bismuth ochre, has a grayish-green, greenish-yellow, to bright yellow color and a grayish to yellow streak. It crystallizes in the monoclinic system but is usually massive, compact granular to earthy or pulverulent. Its fracture is uneven to earthy and its hardness ordinarily is 4.5, but this decreases in the earthy material. The luster of bismite is subadamantine to dull and earthy, and the specific gravity ranges from 8.64 to 10.4. When pure, it contains 89.7% bismuth. Bismite is a secondary mineral, formed by the oxidation of native bismuth and bismuth minerals. It is polymorphous with sillenite, Bi_2O_3, a mineral very similar in physical appearance but crystallizing in the isometric system. Sillenite is also a secondary mineral.

Bismutite is of uncertain composition but is probably a basic carbonate, $Bi_2O_3.CO_2.H_2O$. It is amorphous and occurs in fibrous, incrusting, or earthy and pulverulent forms, (also massive). The mineral is white, green, yellow, or gray in color with a greenish-gray streak and vitreous luster. Its hardness is 4 and specific gravity 6.86 to 7. Like bismite, it is secondary after bismuth or bismuth minerals.

Bismuthenite, Bi_2S_3, known as bismuth glance, has a lead-gray to tin-white color and shows a yellowish to iridescent tarnish; the streak is lead gray. It has a metallic luster, a hardness of 2 and a specific gravity of 6.75 to 6.81. The mineral is somewhat sectile, sometimes flexible, and has one perfect cleavage. Crystallizing in the orthorhombic system, its crystal habit is stout prismatic to acicular; crystals are elongated and striated. However, it is usually massive with a fibrous or foliated texture. It is normally a primary mineral but has been found as an alteration of native bismuth and as pseudomorphs after molybdenite. When pure, it contains 81.3% bismuth.

Bismuth fuses readily and volatilizes on charcoal, giving an oxide coating which is orange-yellow when hot and lemon-yellow on cooling. When fused on charcoal with potassium iodide and sulphur, a sublimate is formed which is yellow next to the assay and brilliant red farther away. A lead sublimate so formed would be yellow. Bismuth crystallizes readily from fusion. It is soluble in nitric acid and subsequent dilution by water causes a white precipitate.

Some bismuth is obtained from ores mined and treated primarily for their bismuth content, but practically all the bismuth production in the western hemisphere is derived from flue dusts from smelters treating ores of copper and lead in which bismuth is a minor constituent. Bismuth is extracted from the ores and metallurgical products by either fire or wet methods or a combination of both. The fire methods account for the greatest production.

The earliest method of treatment was liquation in inclined cast iron pipes heated with wood or coal fires. This process has been superseded by a standard fusion process in crucibles or small reverberatory furnaces with carbon for reduction and suitable fluxes to yield a fusible slag. The products are crude metallic bismuth plus matte or speiss and slag, the latter two usually containing enough bismuth to warrant re-smelting.

In the wet method, which is suitable for the oxide or carbonate ores and metallurgical products, hydrochloric acid dissolves the bismuth, which is then precipitated as bismuth oxychloride by the addition of water. This initial precipitate is washed with hot water to remove as much lead chloride as possible and then is redissolved and reprecipitated. The final precipitate is smelted to crude metallic bismuth.

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Bismuth-bearing flue dusts from smelting operations are generally treated at lead smelters in which the bismuth is collected in the lead bullion. It is recovered from the lead bullion by one of several methods: The Betts process, electrolytic refining of the lead bullion; Betterton-Kroll process; crystallization; and the Sperry process for the electrolytic production of white lead. In the Betts and Sperry processes, the bismuth is recovered from the electrolytic slime, which also usually contains gold, silver, copper, tellurium and lead. Through several steps crude bismuth is produced which has to be refined, as does the crude bismuth produced by all other methods. This is accomplished by chlorine gas and then molten caustic soda. The refined cast product should assay 99.995% bismuth.

In spite of the fact that all domestically produced bismuth is a by-product of the smelting of copper, lead, gold, or silver ores, no custom smelter will pay for the bismuth content of such ores. In lead smelting particularly, the presence of bismuth is objectionable. It is not removed by ordinary refining, and a penalty is assessed, usually being 50 cents per pound or fraction thereof of bismuth in excess of 0.1% of the lead content of the ore. Penalties are not often made in copper smelting but when made, are about the same as for lead.

Production of pharmaceutical compounds continues to consume most of the bismuth used, but the industrial uses of bismuth and its alloys are rapidly increasing. Bismuth possesses unusual thermoelectric properties, but because of its brittlemess, the difficulty of preparing and maintaining wires of suitable size interferes with such use. Some of its fusible alloys show interesting characteristics such as shrinking during solidification and cooling to room temperature and then growing in the solid state until nearly all of the initial shrinkage is compensated for. Most of this growth takes place during the first twelve hours. Machinability of stainless and manganese steels and some strong aluminum alloys is improved by the addition of fractional percentages of bismuth. The bismuth low melting-point alloys find many uses such as the fusible elements of automatic sprinkler heads, solders, dies, etc.

Domestic production of bismuth varies as does the production of lead and copper from domestic smelters and therefore was up in 1947. Imports of ores and concentrates are mainly from Peru with some from Bolivia and Canada. The only record of any California production of bismuth ore was in 1904 when 20 tons were shipped from Riverside County at a value of $2400.00.

The price for bismuth is at the highest level since 1928. On February 20, 1947 it rose from $1.80 per pound to $2.00 per pound, where it remains at this time.

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STATE OF CALIFORNIA
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DEPARTMENT OF NATURAL RESOURCES
WARREN T. HANNUM, Director

DIVISION OF MINES
Ferry Building, San Francisco 11
OLAF P. JENKINS, Chief

MINERAL INFORMATION SERVICE

VOL. 2 April 1, 1949 No. 4

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

CALIFORNIA DIVISION OF MINES REQUESTS

NAMES AND ADDRESSES OF NEW MINERAL PRODUCERS

United States Bureau of Mines, in cooperation with the California State Division of Mines, is now sending out forms to mineral producers requesting statistics of mineral production in 1948. Figures obtained will be compiled in Washington, D.C., in accordance with the following provision of the cooperative agreement:

> "The figures covering the total output of each mineral in the State, with such county break-down as is possible without revealing information obtained in confidence, will be sent to the Division of Mines as soon as the compilation of the data is completed. Figures representing the output of LESS THAN THREE PRODUCERS shall not be disclosed, unless the Federal Bureau of Mines has obtained in writing authorization therefor from the producers interested."

As soon as figures on total production of each mineral in the State of California have been compiled by the United States Bureau of Mines, the figures will be sent to the California State Division of Mines and will be published in the succeeding issue of this Mineral Information Service so that they will become immediately available to the public. At a later date figures will be incorporated in a bulletin that will describe in considerable detail the geology and mineralogy of mineral occurrences in California, the localities where they are mined, their uses, and their markets.

In order that these figures may be made as complete as possible, a request is hereby made that names and addresses of all mineral producers not listed in our last "Directory of Producers of Minerals in California" be sent to the California State Division of Mines, Ferry Building, San Francisco 11, California.

MINING AND INDUSTRIAL NEWS NOTES

Status of Unretorted Gold Amalgam

In response to numerous inquiries from the public regarding sale of unretorted amalgam on the open market, the Division of Mines requested and received the following decision from the Treasury Department:

"You are advised that unretorted amalgam would not be interpreted as gold in its natural state within the meaning of......the regulations issued under the gold Reserve Act of 1934."

Consequently, gold amalgam may not be sold on the open market or to any firm or individual other than to the mint or to a licensed gold buyer.

Mineral Exhibit at Los Angeles Office of Division of Mines

The mineral exhibit at the Division's Los Angeles office has recently been renovated, re-grouped, and enlarged. A group of radioactive minerals is now on display as well as a special exhibit of mica. The Los Angeles office is located in the State Building, 1st and Broadway, Room 402B.

Amador County Copper-Zinc Mine Reopens

Reopening of the Copper Hill mine in Amador County, eight miles west of Plymouth, was started late in 1948. This old mine was first extensively worked from 1861 to 1867 and had a second period of activity between 1903 and 1909 under management of the late W.F. Detert. During these two periods six or more shafts were sunk, most of which were shallow; one reached a depth of 700 feet and a winze from that level penetrated 50 feet deeper. Several thousand feet of levels and raises were driven. Like that of most mines in the Foothill Copper Belt, the ore carries copper, zinc, gold, and silver. Some work was done during the last war in the Jackass or Zinc shaft to a depth of 100 feet. Ore in that shaft was found to be low in copper and high in zinc. In the 200-foot main shaft the ore shipped in the 1900's was higher in copper and lower in zinc than that recently taken from the Jackass shaft. The present operators, Victor Bonnefay and Clarence Miller are re-opening and re-timbering this shaft. Much of the material left on the dumps from earlier mining activity may be of economic value, but it presents the problem of separation of copper and zinc sulfides which is all too familiar to California copper miners. Mr. Bonnefay is doing a great deal of investigation on this problem.

Relocation of the Mine Railroad at Keswick Dam, Shasta County

The spur railroad, serving mines west of the Sacramento River north of Redding, must be rebuilt around the Keswick dam and reservoir. R.A. Heintz, contractor, of Portland, Oregon, submitted a low bid of $1,744,619 for the relocation. The new portion of the railroad will leave the present grade at Middle Creek about two miles west of Redding at an elevation of 522 feet. After traversing a distance of seven miles, it will again connect with the present grade about a mile below Matheson at an elevation of 592 feet and continue along the river bank at Shasta dam. The railroad was formerly on the main line of the Southern Pacific Railroad before the Shasta dam was built, but the old main-line grade above the dam is now under several hundred feet of water. At the time of construction of the Shasta dam a new grade for the main-line had to be built. Now, a portion of the spur track to the mining districts must likewise be rebuilt to accomodate the waters of the Keswick dam.

Utilization of California Crude Oil 1947-1948

Most of the crude oil produced in California is sent from wells to storage reservoirs at tank farms near the oil fields and from these reservoirs by pipe lines to refineries. The larger refineries are located in the vicinity of Los Angeles or on San Francisco Bay.

Crude oil consumed in California during 1948, according to the compilation from E.T. Knudson in "Monthly California Petroleum Statements for 1948" published by U.S. Bureau of Mines, was 313,958,000 barrels sent to the stills at the refineries; 6,946,000 barrels shipped outside the state; and 19,283,000 barrels consumed either as fuel or added to residuum. The stock of crude petroleum was increased by 3,479,000 barrels over that of 1947. For comparison, the following figures for 1947 were given: 304,768,000 barrels of petroleum sent to the stills at the refineries; 6,088,000 barrels shipped outside the state; and 25,493,000 barrels either consumed as fuel or transferred to residuum. Stocks were increased by 2,302,000 barrels over those of 1946.

Output of Petroleum Products During 1947-1948

	Barrels of 42 gal. 1947	Barrels of 42 gal. 1948
Crude petroleum to stills	304,768,000	313,958,000
Natural-gas-gasoline	16,519,000	16,782,000
Totals crude oil & natural-gas-gasoline	321,287,000	330,740,000

	Barrels of 42 gal. 1947	Barrels of 42 gal. 1948
Gasoline & naphtha distillates	122,848,000	125,881,000
Kerosene & kerosene distillates	5,441,000	4,668,000
Lubricating oil and greases	4,566,000	3,744,000
Gas oil and diesel oil	53,269,000	57,398,000
Fuel oil & residuum (including heavy non-gasoline crude) a/	107,402,000	113,181,000
Asphalt & road oil	10,636,000	10,077,000
Coke & other finished products b/	2,432,000	2,789,000
Refinery shortages and gas c/	12,437,000	11,058,000

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a/ Heavy non-gasoline crude included with fuel and residuum	25,493,000	19,283,000
b/ Coke equivalent in barrels	1,576,000	1,605,000
Wax	91,000	88,000
c/ Refinery gas equivalent in barrels	10,641,000	10,321,000
M cu ft	48,651,000	47,932,000

THE MINERAL NEEDS AND MINERAL PROBLEMS OF THE CERAMIC INDUSTRY

by H.R. Goodrich, Manager of Production,
Gladding, McBean & Co., 1275 Harrison Street, San Francisco.

ANDALUSITE, KYANITE AND OTHER HIGH ALUMINOUS MATERIALS

The Refractories Industry is always in search of minerals of the high alumina type, the most important of which are andalusite, kyanite, sillimanite, dumortierite, topaz, diaspore, and bauxite. Prior to the World War II, India was the principal source for kyanite, this being brought into this country in lump form calcined in this form to ease the crushing and grinding problem, following which it was crushed and screen-sized to meet the needs of the various manufacturers in their particular problems of manufacturing high temperature refractory specialties and brick. During and following the war, there have been domestic developments aimed at replacing this foreign source, and most of these have been located in the southern states, principally North Carolina and Virginia. Here they have operated on the principle of crushing, screening, and flotation and have produced a highly satisfactory product in the smaller grain sizes, but the Refractories Industry at present is still in need of large particle sizes of this mineral to satisfy certain needs in the high temperature refractories field. So far, no domestic sources of kyanite have been discovered that are either pure enough in boulder or lump form to permit of use without concentration or that resist fracturing and disintegration during the calcining process. Andalusite and dumortierite, which often occur together, would find considerable use in this same field if suitable deposits were located that would permit of more economical operation than those now known, such as the well-known deposit in the White Mountains above Laws, California.

The aluminous minerals such as corundum and topaz are also in demand by the refractories industry, some considerable use having been made of topaz crystals, either calcined or raw. The earthy high alumina-minerals such as bauxite, diaspore and gibbsite have had wide use by the midwest refractories manufacturers for many years but the Pacific Coast geology does not favor much opportunity of locating these minerals in these states. The deposits of Missouri are nearly depleted of quality minerals of this type and the problem is of considerable concern to the users of these minerals in the midwest and east.

BARITE

The ceramic industry is a large consumer of precipitated barium carbonate derived from the mineral barite. It is used by clay product manufacturers to eliminate white sulphate scum from the surface of their products and for this reason they are concerned with its continued availability. During the war, this product was somewhat scarce in the form used, as the manufacturers were required to devote their main production to barium peroxide. The present industry seems to be entirely capable of supplying the ceramic needs now that they are back to normal operation.

CLAYS

A. Ball Clays

During the last ten years California has rapidly become one of the major pottery and dinnerware manufacturing centers of the country. For many of these products a ball clay of high purity and plasticity is required and no clay of this quality has so far been obtainable from this area in commercial quantities, all of it being obtained from the Kentucky-Tennessee area or from England. Clays of sufficient plasticity and of a pale buff color when fired satisfy some of the needs of this industry and are obtainable from the Lincoln, Ione, Elsinore, and Alberhill areas of the state.

B. China Clays

China clays are usually developed by the washing of kaolin-quartz mixtures resulting from the weathering or alteration of feldspathic rocks. Good quality kaolin is now being produced in southern California by this process in the vicinity of El Toro, and in past years other deposits have been worked including one at Ione and one in Nevada. Very considerable quantities of china clays and kaolins are being imported into California from the southern states and from England. The ceramic industry is a very critical buyer of both china clay and ball clay as uniformity of supply and surety of continued availability are prime requisites almost equal to that of quality.

C. Refractory Clays

The refractories industry of this area has a wealth of supply of refractory clays of the high heat duty, intermediate, and low heat duty grades occurring in both the Ione and Lincoln areas and still have many years of supply of clays of super-duty quality. As in the midwest, however, they are in continual search of clays of super-duty quality and other high alumina minerals as discussed under the heading of andalusite. In southern California are similar sizable reserves of clays of high heat duty to low heat duty quality, but proved deposits of clays of super-duty quality are either limited or involve high recovery costs.

D. Red-Burning Clays

The red-burning clays of the state are highly plentiful, and because of the relatively low sales value of the products made from this type of clay, the sources closest to the consuming centers usually are the deposits in operation. Most of the manufacturers of red-burning products are interested in testing samples of materials occurring in their own vicinity, as sometimes some particular property of a deposit may reduce their manufacturing losses and justify slight additional mining and freight charges.

FELDSPAR

The principal users of feldspar are the sanitary-ware manufacturers. Some further consumption is by the pottery manufacturers, who use it for both their bodies and glazes. The principal Pacific Coast source is from the mine and mill at Kingman, Arizona. The eastern states have also been a major source of supply but have had difficulty in meeting the local demands in recent years. This is reported as being due to their having to resort to cleaning and concentration of their raw product through depletion of their high-purity material. A desirable type of feldspar for the ceramic industry is one of high purity; one free from iron contamination and relatively high in potash and soda, both the latter lending low fusion and white fired color to the ceramic batch.

SILICA

The ceramic industry consumes sizable tonnages of ground silica, mostly of the 200-mesh particle size. Purity and freedom from iron specks are the principal requirements of a satisfactory grade of ground silica. At present the principal sources of ground silica for use by the Pacific Coast ceramic manufacturers are Illinois and Kingman, Arizona.

TALC

The wall-tile, pottery, and earthenware-dinnerware manufacturers in California consume large tonnages of ground talc of a type classified in trade circles as "hard" and "soft" talc. These talcs are generally unlike the pure steatite talcs in that they often contain varying amounts of other minerals of the talc family such as tremolite and quantities of calcite and dolomite in amounts up to 10%. The usual screen size of these talcs is of the grade known as 200-mesh, and the present suppliers seem capable of satisfying the market demand. Most of this material is mined from the deposits in San Bernardino and Inyo Counties, the milling and sacking being carried on either near the mine locations or in the Los Angeles area. Inyo County of California and Esmeralda County of Nevada also produce high quality steatite talc for use in the production of electric and radio insulators, much of which is processed by eastern manufacturers.

ANNUAL MEETING OF THE ASSOCIATION OF AMERICAN STATE GEOLOGISTS

The Association of American State Geologists held its annual meeting at the offices of the California State Division of Mines, February 11-12. Topics discussed included:

1. Relation of the Association to federal government bureaus, particularly the U.S. Geological Survey and the U.S. Bureau of Mines.
2. State surveys and water resources investigations.
3. Marketing and utilization of minerals.
4. Federal-State cooperative mapping projects.
5. Mine map repositories.
6. Well cuttings laboratory.
7. Policies connected with the Journal of the Association of American State Geologists.

A field trip conducted by staff members of the California Division of Mines traversed selected parts of the Berkeley Hills in Alameda and Contra Costa Counties, the San Andreas rift zone, and other areas of geologic interest in Marin County. A guidebook which included an areal geologic map and structure sections was prepared by staff members of the Division and published in February 1949 Mineral Information Service.

State Geologists who attended the meeting were Walter Jones of Alabama, H.F. Foxhall of Arkansas, Olaf P. Jenkins of California, Ben Parker of Colorado, Chester Longwell of Connecticut, Garland Peyton of Georgia, Morris Leighton of Illinois, Charles Deiss of Indiana, Leo Hough of Louisiana, Joseph Singewald of Maryland, Gerald Eddy of Michigan, George Schwartz of Minnesota, Edward Clark of Missouri, F.A. Thompson of Montana, Jay Carpenter of Nevada, Meredith Johnson of New Jersey, Wilson Laird of North Dakota, John Melvin of Ohio, F.W. Libbey of Oregon, S.H. Cathcart of Pennsylvania, and Sheldon Glover of Washington.

NATIONAL MEETING OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

A very fine series of business and technical sessions marked the 77th annual meeting of the American Institute of Mining and Metallurgical Engineers held at the Fairmont and Mark Hopkins Hotels in San Francisco, February 13-17. Few such meetings have received more enthusiastic local and nationwide response. Delegates were exposed to a world of information concerning every branch of the mining industry; both domestic and foreign topics were discussed. It was unfortunate that many of the fine papers had to be presented concurrently so that many had to be passed up. Airplane flights over the San Francisco Bay industrial and mining areas, and field trips into the Berkeley Hills, Marin County, and New Almaden mine areas were among the features of the meeting.

California Division of Mines staff members contributed to various parts of the program. Olaf P. Jenkins, Chief of the Division, spent a great deal of time on various planning and program committees. Mr. C.W. Chesterman, Associate Geologist gave a beautifully illustrated talk on the pumice and perlite deposits in California. Mr. Lauren A. Wright, Associate Geologist, presented an interesting paper on California talos. Miss Mary E. Helm, Geological Draftsman, assisted by various other staff members prepared a guidebook of the San Francisco Bay area for use on one of the field trips.

The State Division of Mines also maintained a booth at the Fairmont Hotel during the meetings to acquaint the public with the work and publications of the Division. The booth was in charge of Miss Elisabeth Egenhoff and Miss Geil Bartels, both of the Division's technical staff.

ROCK-COLOR CHART

Geologists and other technical authors in the field of earth science will be interested in the rock-color chart published by the Division of Geology and Geography of the National Research Council. The following excerpt from p. 533 of Economic Geology, vol. 43, no. 6, September-October 1948 is self-explanatory:

"This chart is designed especially for field use but is suitable also for use in the office or laboratory. It consists of 8 sheets, 5 by 7½ inches, and will fit conveniently in the back of a field notebook. It includes 115 colors which indicate the range of rock colors for all purposes, and a brief text explains the systems used for the chart arrangement and the color names. The form and arrangement are based on the Munsell system and the color names have been taken from the ISCC-NBS system as described in National Bureau of Standards Research Paper RP 1239. Also, the Munsell numerical designation is placed under each color for the use of those geologists who wish to make fine color distinctions. The base chart was printed by the Government Printing Office and the color chips have been hand colored and stuck on the charts by the Munsell Color Co. of Baltimore, Md. The colors are as permanent as possible, and the red, yellow and brown ranges have been used successfully on the Soil Color Names Charts of the Department of Agriculture for nearly 10 years. The Rock-color Chart was prepared by the Rock-color Chart Committee representing the following organizations: E.N. Goddard, Chairman, U.S. Geological Survey, Parker D. Trask, G.S.A., Ronald K. De Ford, A.A.P.G., Olaf N. Rove, S.E.G., Joseph T. Singewald, Jr., and R.M. Overbeck, Ass. of Amer. State Geologists. This committee was made a subcommittee of the Committee on Symposium on Sedimentation, Division of Geology and Geography of the National Research Council."

The chart may be obtained from the National Research Council, Division of Geology and Geography, Washington 25, D.C., at a cost of $5.50 per copy.

AMADOR COUNTY

Geologic Features

Amador County lies between the South Fork of Cosumnes River on the north and Mokelumne River on the south. The land rises gradually from the eastern border of Sacramento Valley on the west to the western summit of the Sierra Nevada. Most of the streams flow southwest and are tributaries of Mokelumne River.

Extending northwest across the westernmost part of the county are Eocene sedimentary beds which are economically important because of the clay and lignite deposits found in them. These beds dip slightly to the west and cover the lower western bedrock slope which consists of a complex of amphibolite schist, Jurassic slate, and Carboniferous slate and schist. These tightly compressed and metamorphosed basement rocks strike uniformly northwest, dip steeply northeast and outcrop in a belt 8 miles wide. Some copper ore occurs in the amphibolite schist in the western part of the belt and the Carboniferous members contain many small deposits of high-calcium limestone. Along the east border of this complex, a band of greenstone (meta-andesite) is in contact with the Jurassic clay-slate of the Mother Lode. The slate and contact zone is traversed in the northwesterly direction by the Mother Lode reverse fault. The 10 miles of this fault zone which crosses Amador County has been most important in gold production. For 10 miles or more east of the Mother Lode the exposed rocks are principally the Carboniferous (Mississippian) series of hard slate, schists and quartzite, penetrated in only a few places by outliers of the Sierra Nevada batholith, and capped here and there by remnants of volcanic debris which followed ancient stream courses flowing from the mountains to the east. The most important deposits here are large beds of limestone, mostly undeveloped, at Volcano and near Fiddletown. Numerous small gold mines occur in the Carboniferous rocks and in the western part of the granitic batholith which adjoins them on the east. This is the East Belt, in which the ore bodies are smaller and ore more complex but frequently richer than in the Mother Lode.

Mineral Resources

Amador County has been noted for its Mother Lode deposits of gold ore, which have been worked to a vertical depth of over one mile below the surface. The lode gold production of the county has been second in California only to that of Nevada County.

Next in importance are the clay deposits of the Ione and Carbondale districts, where both open-pits and underground mines have supplied for years a variety of clays from the Ione (Eocene) beds. Part of the clay is highly refractory. One plant for pottery is in operation in the county, but clay is shipped to many other plants in different parts of the state.

Lignite was mined for many years prior to 1902 from deposits associated with the Ione clay. Two lignite deposits are now being reopened. Limestone and marble are plentiful and have been produced in years past. Miscellaneous stone is produced for local use. Other minerals produced in the past include asbestos, copper and copper ores, chromite, gem minerals (diamonds and chrysopal), manganese ores, by-product platinum, lead and silver (from gold and copper mining), soapstone, silica sand, sandstone, and slate. Rock wool has been produced the past few years from old copper smelter slag.

Significant Activities of 1947

The continued increase in labor and material costs has hampered resumption of gold lode mining and prevented reopening of several mines. The Central Eureka Mine at Sutter Creek is being rehabilitated and should be producing in 1948. The Belden Mine on the East Belt has been the most important operation among the small mines in that region, where ores are in some cases rich enough to permit work even at present high costs. The Argonaut Mine management has decided to dissolve the company because of present unfavorable conditions, and not due to the exhaustion of ore. In 50 years of operation, this mine produced over $25,000,000 and paid $3,789,750 in dividends on a capitalization of $1,000,000. The deepest level, at 6300 feet inclined depth, is 5570 feet vertically below the shaft collar, or 4000 feet below sea-level, making it the second deepest mine in the state, exceeded only by its neighbor the Kennedy which is also closed.

Mining and shipment of copper ore from the Newton Mine near Ione ended with the expiration in mid-year of the bonus paid by the United States Government. Clay production has continued at a good rate. A new plant was completed by De Angelis Coal Company at the Buena Vista lignite mine, and experimental work started late in 1947 on the production of montan wax, mineral pigments and briquettes from lignite mined at that property and another deposit near Ione.

Mineral Production in 1947

Product	Quantity	Value
Clay, raw	198,264 short tons	$380,496
Copper	1,674,000 pounds	351,540
Gold	4,724 troy ozs.	165,340
Silver	11,598 troy ozs.	10,496
Unapportioned (pumice, sand and gravel and stone)	------	5,317
Total value	------	$913,189

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REFERENCE LIST OF RECENT PUBLICATIONS

The references listed below are available for study in the Library of the Division of Mines but are not on sale by the Division.

Alf, Raymond M., Mylonite belt in the southeastern San Gabriel Mountains, California: Geological Society of America Bulletin, vol. 59, pp. 1101-1120, 5 plates, 3 figs. November 1948. Describes the unusual occurrence of mylonite and discusses its relation to the geologic history of the San Gabriel Range.

Backman, Jules, The economics of the potash industry, American Potash Institute, Inc., 55 pp. 2 maps, 48 charts, Washington, D.C., 1946. Discusses the sources of potash in the United States with extensive reference to the Searles Lake deposits.

Barnett, C.E. and Durland, G.R., Luminescence of minerals and synthetic compositions: Mining and Metallurgy, vol. 29, pp. 603-605, 2 tables, November 1948. Discusses the various luminescence phenomena including those connected with synthetic and natural phosphors together with some practical applications of luminescence.

Jenny, Hans, et al, Exploring the soils of California, California Agriculture, 435 pp., 23 figs., University of California Press 1946. A very complete work on California soils including biochemical processes, mineralogy, fertilizers, etc.

Kilkenny, J.E., Geology and exploration for oil in Salinas Valley, California: American Association of Petroleum Geologists Bulletin, vol. 32, pp. 2254-2268, 3 figs., December 1948. Discusses the history of oil exploration in Salinas Valley including considerable data on stratigraphy and structure.

Mathesius, Walther, Iron and steel in the intermountain and west coast areas: Mining and Contracting Review, vol. 50, no. 22, pp. 5-7, 12, November 30, 1948. An historical summary of steel operations in the west. The availability of raw materials is discussed.

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Torrey, Paul D., A preliminary statement on secondary recovery prospects and possibilities in various parts of the United States: Interstate Oil Compact Commission Quarterly Bulletin, vol. 7, pp. 60-65, September 1948.

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MINERAL INFORMATION SERVICE

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MAY 11 1949

MINING AND INDUSTRIAL NEWS NOTES

Orange County Clay and Silica Sand Plant Operation

The silica sand grinding section of a new clay and silica sand plant, located 7½ miles northeast of El Toro in Los Alisos Canyon, was placed in operation in the early part of March, 1949, by W.A. Schoeppe, P.O. Box 101, El Toro, and I.P. Arnold, 7655 E. 2nd Street, Downey, California. Ultimate production will include both high quality silica sand and high-grade china clay for the ceramic industry. Equipment in the sand section includes a 6-foot by 16-foot pebble mill, Dings stationary magnet, 10-foot by 32-foot by 12 inch drier, all housed in a new 40-foot by 100-foot steel and aluminum sheeted building. Both diesel and electric power are available. The clay washing section, now under completion, will handle 30 tons of material per day from the Robinson Ranch deposit in the Trabuco Canyon area.

New Gold-Silver Ore Treatment Plant at Silver Lake, San Bernardino County

The California Silver Corporation has started erection of a 50 ton amalgamation and flotation mill at Silver Lake, 7 miles north of Baker, California. Ore from the Company's Silver Hill mine near Riggs will be trucked 12 miles for processing at the new plant. Foundations are being poured and milling equipment purchased is being delivered. Water will be supplied by a well developed in early days by the Pacific Coast Borax Company at the Silver Lake station of the abandoned Tonopah and Tidewater Railroad. Operations of the California Silver Corporation are under the direction of W.R. Long, Vice-President, 12707 Matteson Ave., Venice, California. Corporation headquarters are at 5177 Overland Ave., Culver City, with Horace L. Richardson, President, and Russell E. Riner, Secretary-Treasurer.

New Aggregate Plant at Yreka

Old placer tailing is being mined to a depth of eight feet with a dragline for a sand and gravel plant on Yreka Creek about three miles north of Yreka. Instead of being hauled in trucks, material under three inches in size is pumped to the screening plant by a centrifugal pump through 300-feet of 6-inch steel pipe.

The operators, Eugene Yeager and Leland Maloy, claim that the sand and gravel is more thoroughly washed free from silt and clay by this method than it could be by just washing it with sprays at the screens.

The power and pumping plants are mounted on a barge built on four large navy rafts, which were purchased from surplus stocks.

The partners have been operating the plant at this location for about a month, One hundred and twenty-five cubic yards of sand and gravel is produced per day. It is used for concrete aggregate in the Yreka area.

GYPSUM IN CALIFORNIA - ITS OCCURRENCE AND USES

Gypsum is hydrated calcium sulfate having the formula $CaSO_4.2H_2O$. Frequently it is associated with anhydrite, $CaSO_4$, a material for which no use has been found in California. Gypsum deposits of commercial size usually occur either as rock gypsum interbedded with other rocks, particularly shale and limestone, or as the powdery low grade form gypsite. California has large reserves of both types. Gypsite is found mainly in the San Joaquin valley along the southwest margin from Little Panoche Creek to Maricopa; also near Soda Lake, San Luis Obispo County, and other places which have a very dry climate. Individual gypsite deposits are usually low grade, small, and irregular. They are found, however, at or within a few inches of the surface of the ground, and mining may be done with shovels or scrapers.

Rock gypsum often occurs in large uniform deposits which run over 90 percent gypsum. Rock gypsum is produced in Ventura County near Ventucopa, in Riverside County near Midland, and in Imperial County near Plaster City. There are also large undeveloped resources in the southeastern desert, which are far from railroad or highway.

In addition to these sources of natural gypsum, artificial gypsum is produced at Newark from bittern in connection with the manufacture of magnesia.

Because raw gypsum is a cheap commodity, only those deposits which lie close to cheap transportation are of economic interest. Deposits outside of the state which are favorably located compete successsfully with those within its borders. Gypsum comes by rail from Arden and Gerlack in Nevada and by ship from San Marcus Island in the Gulf of California.

In 1946 the California production of raw gypsum amounted to 618,007 tons. Consumption is estimated at 851,786 tons, of which 414,286 tons were used as soil amendment in agriculture, 107,500 tons as a retarder by the portland cement industry, and most of the remainder was used by the plaster industry for the manufacture of gypsum wallboard and lath, hardwall plaster, casting plaster, and plaster for minor special uses.

The use of gypsum in agriculture has increased over 100 times during the past 15 years. One function is to provide a source of both sulfur and calcium for plants growing in soils which are deficient in these elements. Additions of gypsum are particularly useful for this purpose where the soil is not acid.

Probably a more important function is the conditioning of alkali soils. In soils the clay molecule has a large number of negative charges to which positively charged cations are attached. For the successful growth of plants at least half the cations should be Ca^{++}. An alkali soil contains not only an excess of Na^+ and K^+ cations, but it may contain sodium carbonate which is harmful to plants. An excess of Na^+ ions causes the soil to deflocculate and to become very hard when dry. This condition can be corrected by the addition of gypsum.

Of the impurities commonly found in gyspum, most are inert and are harmless to plants. Boron, which occasionally is found with gypsum, is a very harmful impurity, for over 1/2 part per million is toxic to plants. Agricultural gypsum must be finely ground, but ordinarily gypsite is divided finely enough not to require any treatment whatever.

Agricultural gypsum is classified by law as an "Agricultural Mineral" and must be sold in accordance with the provisions of the Agricultural Code of California. The law requires in general that a producer must be registered and that each lot must be properly labeled. Although there are no requirements covering the percentage of gypsum necessary, frequent inspections are made to see that the product contains the guaranteed ingredients and is properly tagged.

The portland cement industry uses raw gypsum as a retarder. About ten pounds per barrel are added to the clinker before grinding. Cement mills require a product which runs 92 to 93 percent $CaSO_4.2H_2O$. Anhydrite is considered harmful and should be less than 3 percent. Insoluble material is also undesirable, for the specifications of the finished cement are rigid, and too much insoluble material added with the gypsum might raise the amount in the finished cement above the permissible limit. Lime is not a critical impurity, but too much is probably harmful. Almost all cement plants require gypsum of a particular size. Probably a majority are accustomed to using and require "pebble" gypsum which is plus 3/8 inch and minus 1½ inches. Some, however, use finely ground gypsum, and a very few are equipped to handle both pebble and finely ground gypsum.

In California only a few operators of portland cement mills use gypsum produced in California, and one of these owns his own deposit. The majority use gypsum brought in either by sea or by rail, although attempts have been made by cement companies to obtain satisfactory deposits in California. Because of the necessity of producing a sized product and the expense of this screening operation, the portland cement industry is not an attractive market for the small producer.

The plaster industry is the largest user of raw gypsum, and the plaster produced is about equally divided between gypsum board, including lath, and hardwall plaster. Minor uses are for gauging, casting, dental, and special plasters. Gypsum which has been partly dehydrated to the semi-hydrate ($CaSO_4 \cdot \frac{1}{2}H_2O$) will, when mixed with water, soon harden or set. Calcined gypsum which has received no further treatment is called stucco in the industry.

In California there are five calcining plants. One is in the Bay Area, two near Los Angeles, the remaining two are in the southeastern desert close to gypsum deposits. The three plants in the metropolitan areas obtain gypsum from outside the state. One of these plants uses a comparatively low grade deposit which is, however, suitable for cheap mining and is close to rail transportation. It is considered that a dependable supply of gypsum at a considerable distance is preferable to a less dependable one close by even at some sacrifice of quality. There seems to be no uniformity of opinion concerning the location of the calcining plant with respect to deposit and market. Two of the California plants produce gypsum board and lath only; the others manufacture hardwall, casting, gauging, and other plasters in addition to board products.

Calcining must be done under carefully controlled conditions at a temperature which varies from 250° to 350° F. Overcalcining produces dead burned gypsum or anhydrite which will not rehydrate. Uncalcined lumps of gypsum act as powerful accelerators and are highly objectionable because the plaster sets too quickly.

In the past, calcining has been done in batch machines called kettles, and even today the kettle is used for all but the lower grades of stucco. The typical California kettle is a brick lined steel cylinder heated from below by an oil or gas fired furnace. Four large horizontal flues connected to the furnace provide additional heat. The boiling action, caused by the water of hydration being driven off during calcining, produces the necessary agitation, but there are in addition rabble arms close to the bottom to prevent sticking. Feed for kettles is first crushed in hammer mills and then ground in Raymond mills in closed circuit with air separators to produce a material about 80 percent through 100 mesh. A charge consists of about 10 or 12 tons. During calcining, which takes about 2¼ hours, the operator keeps a close watch on the kettle and on the temperature which is recorded by a recording pyrometer. A temperature of 250° F is maintained at first which is raised to 350° F near the end of the calcining period. The finished batch of stucco is dumped into a hot pit immediately below the kettle where calcining probably continues. From here stucco is taken to storage bins by screw conveyors.

Stucco can be made by continuous methods, but at present it is not possible to produce a product sufficiently uniform for all purposes. Calcining may be done in rotary calciners or by Raymond Imp mills which combine fine grinding and calcining. Two of the five California calcining plants use the Imp mill.

The Raymond Imp mill is essentially a hammer mill through which are passed the hot gasses from an adjacent furnace. Feed may be up to 1½ inches in size, and too high a proportion of fines should be avoided. One producer is able to use a feed consisting of coarse gypsum with up to 50 percent of very finely divided artificial gypsum. Gasses enter the mill at 1700° F, and stucco is withdrawn at 350° F, 90 percent minus 100 mesh. It is then passed through a separator for the removal of furnace gasses and steam.

For hardwall plaster kettle stucco is reground dry in tube mills containing steel balls, for it has been determined that the particles of the shape formed in ball mills produce better hardwall plaster than those formed in other grinding machines. The ground stucco is then mixed with fiber, often sisal fiber, sometimes sand, and a retarder. The retarder commonly used is organic matter such as hoofs or hair which has been digested in caustic. Plaster manufacturers ordinarily purchase retarder, but one California producer prepares it from hoof meal, lime, caustic, and cement mill dust.

Stucco for casting plaster is reground in buhr mills.

Gypsum wall board and lath require stucco of less rigid specifications than do other plaster products. Calcining may be done in rotary or flash calciners, and one operator uses raw material which carries only about 80 percent gypsum. Board and lath are made on machines which are almost entirely automatic, such as the Ehrsam machine. Either board or lath of several different lengths, widths, and thicknesses can be made on the same machine. Special papers are used on both sides of the plaster core.

Dry ingredients are stored in bins near the machine and mixed in the screw or drag chain conveyors which carry them to the board machine. To the stucco a filler such as sawdust is added. A small amount of soap is added to promote the formation of bubbles in the slurry to give additional porosity. Starch or corn meal promotes the sticking of the plaster to the paper by protecting the fine gypsum crystals which penetrate the paper from calcining during drying. An accelerator is also added. One operator uses punchings from the lath which are dried and ground, another salt water, and a third gypsum and potassium sulfate.

Near the head of the machine the dry ingredients are mixed with water in a pin mixer to form a rather thin slurry which is deposited on the bottom layer of paper as it moves from the stock roll toward the forming rolls. The top layer of paper is fed on immediately ahead of the forming rolls where the projecting edges of the bottom paper are doubled over and sealed. This wet "sandwich" is supported first on a moving belt and then on rollers until the gypsum has partly set. Near the end of the machine holes are punched when lath is being made, and the continuous sheet is automatically cut into sections, which then pass at a greatly accelerated speed to the end of the machine.

The board must then be dried. It is standard practice to use a Coe drier placed parallel to the board machine and to pass the board back through it. The Coe drier consists of six or eight decks of moving rollers which carry the board slowly through several sections heated by steam coils. An elaborate system of transfer belts and an automatic tipple take the sections of wet board from the board machine and place them in the drier. A typical drier consists of three or more sections heated by steam coils and equipped with blowers to provide circulation and to aid the drying. A temperature of about 200° F is maintained in the first section in order to drive the water from the board quickly. This is reduced in the following sections in order to eliminate the possibility of recalcining.

In most plants the finished board is removed from the drier and stacked by hand, but in some cases this is done automatically. Some operators feel that handling the finished board provides an opportunity for inspection which justified breakage caused by carelessness.

TALC

The mineral talc is a hydrous magnesium silicate with a theoretical chemical formula of $H_2Mg_3(SiO_3)_4$. It has a specific gravity of 2.7 to 2.8, perfect cleavage, and a greasy feel; but its most characteristic property is its unusual softness (1 to 1.5 on Mohs scale). The mineral occurs in fine to coarse-grained aggregates, the grains of which may be equant, foliated, or fibrous. When pure, it is a white, light gray, or light green mineral, but impurities commonly impart other colors.

The names "steatite" and "soapstone", as applied to talcose substances, are also widely used. "Steatite" in its original meaning implied a compact, blocky talc that could be easily carved but which was not necessarily pure. Current industrial usage of the term refers to unusually pure talc that can be used as a raw material in the manufacture of high-frequency electrical insulators. "Soapstone" is a term generally applied to any impure talcose material.

Industrial talcs rarely consist of the pure mineral but are mixtures of minerals most of which are high-magnesium silicates and among which the mineral talc is usually a prominent constituent. The most common associated minerals are tremolite, serpentine, chlorite, anthophyllite, carbonates, and quartz. The chemical composition of industrial talcs, therefore, seldom approximate that of the pure mineral. These associated minerals may be beneficial, harmless or undesirable, depending upon the industrial usage to which the material is put. Sulphides, sulphates, and iron and manganese oxides may also be present and usually are undesirable constituents.

More than three-fourths of the talc produced in the United States is consumed in five industries - paint, rubber, roofing, ceramics, and insecticides. Cosmetic and paper manufacture use much of the remaining fraction. In most uses whiteness of the ground material is a desired property. Where talc is used as a lubricating agent, as in the rubber industry, a high degree of smoothness and "slip" is necessary. In the paint industry, where employed as an extender, talc is used that has good oil adsorption and a fibrous or flaky form. These properties lend good coverage and luster to the pigment. The use of talc in the ceramic industry is dependent upon the presence of some or all of the following qualities: high fusion point, low shrinkage, low electrical and thermal conductivity, and high specific heat and resistance to heat shock.

Commercial talc deposits have most commonly been formed by alteration of dolomites, limestones, and ultrabasic rocks. A few deposits occur in magnesium-poor crystalline rocks. The bulk of the domestic commercial talc, including nearly all of that produced in New York and California, are of the altered carbonate type. Many of such deposits are associated with rocks of relatively high metamorphic grade which have been extensively invaded by igneous rock, the talc representing a late stage alteration of magnesium silicate minerals that had formed previously in the metamorphic history. Outstanding examples of this type are in the pre-Cambrian rocks of the Gouverneur district in northern New York State. The Silver Lake-Yucca Grove area of San Bernardino County, California, contains similar, though less extensive, deposits also in a pre-Cambrian terrane.

In California, in the case of deposits of the Southern Death Valley and Kingston Range area in Inyo and San Bernardino Counties, the talc has likewise formed by alteration of magnesian carbonate rocks that are part of the lowermost late pre-Cambrian formations of the regions, but here, associated sedimentary beds are but slightly metamorphosed and the talc bodies are near or next to diabase sills.

Both of the above types of California deposits are characteristically tremolitic and large portions of a deposit may contain little or no talc.

In contrast to these are the deposits of the Inyo Range area, Inyo County, many of which contain steatite of unusually high grade silica and from which tremolite is notably lacking. The talc has formed chiefly from alteration of Paleozoic dolomite, to a lesser extent from silica rock, and, at least on one property, from a granitic rock.

Soapstone is obtained in California from belts of serpentine and talc-actinolite schist along the western foothills of the Sierra Nevada. To date, material from these deposits has been marketable chiefly as a filler in roofing manufacture and, in recent years, as an insecticide carrier. It has not commanded the price of talcs obtained from the eastern part of the state and production has been comparatively small.

Commercial talc bodies tend to be elongate and lenticular. The largest in New York State reaches lengths of several thousand feet and widths of 200 feet or more. Several talcose zones of the southern Death Valley - Kingston Range area of Californi are greater than a mile in length, but in most cases these do not contain commercial talc throughout. Commercial bodies in this area rarely exceed 50 feet in width. The largest talc bodies of the Silver Lake - Yucca Grove area are several hundred feet in length and seldom exceed 25 feet in width.

Zoning in many of California's tremolitic talc deposits permits selective mining of talcs of contrasting textures and mineral composition. In the Silver Lake area, for example, concentrations of relatively pure talc tend to lie west next to the footwall; the hanging wall material is preponderantly tremolite. In the highly tremolitic deposits of Southern Death Valley - Kingston Range area these spatial relations are reversed.

Most of the tremolitic material is marketed to ceramic plants in the Los Angeles area. It is consumed in the production of floor and wall-tile and constitutes from 50 to over 75 percent of the raw mix. In common practice tremolite-rich and talc-rich materials are blended to meet ceramic specifications. Blends with a relatively wide range in talc-tremolite proportions have been used successfully. Different proportions however, require different firing temperatures and once a mix has been adopted by a ceramic plant the maintenance of mineralogically uniform talc is of fundamental importance.

Tremolite-poor talcs from the Southern Death Valley - Kingston Range are also marketed for non-ceramic uses, principally in the paint and textile industries. Nearly all of the high-grade steatite produced in California is consumed in the east in the manufacture of electrical insulator bodies.

Talc mining throughout the United States is largely by underground operations, though several of the soapstone sources of California's Sierran foothill belt are open cuts. Relatively steep dips characterize most talc deposits. In common practice a shaft is sunk on the talc and drifts, also on talc, are extended at several levels. The talc is removed by raising between levels and development of sub-level stopes. Early operations at deposits exposed on hillsides have commonly employed adits, but as the body has been followed downward winzes or shafts have been necessary. The incompetence of talc bodies has required extensive timbering at many times.

The milling of talc is essentially a grinding and air separation operation, though eastern talcs are locally beneficiated by wet flotation. Current practice is to grind to several grain size distributions depending on the use to which the talc is to be put. In general, the coarsest California ceramic talcs are ground to pass 96 percent through a minus-200 screen; other talcs may be ground to 99.5 minus-200 mesh or 99.5 percent 325 mesh. Fines with a size range of from 2 to 40 microns are marketed separately.

Mills in the Los Angeles area handle most of the talc mined in California, though some is processed in Ogden, Utah. Two mills in California, one at Keeler and another at Dunn between Barstow and Baker, are relatively close to the talc-producing areas.

Prospecting for talc in California can best be pursued in well-defined areas. The talc thus far produced has come almost entirely from two narrow belts; one along the western foothills of the Sierra and another close to the central portion of the eastern border of the state. The low-grade Sierran deposits are generally very large and production from them will depend on availability of markets and transportatio costs. To date, no talcs comparable with those of the eastern belt have been obtained. The eastern belt extends for approximately 200 miles from the northern portion of the Iuyo Range to the vicinity of Baker. Particularly favorable prospecting conditions are provided in the Southern Valley - Kingston Range area where the talc occurs within narrow stratigraphic limits and associated with diabase sills.

BUTTE COUNTY

Butte County lies at the junction of three major California geomorphic provinces. The southern terminus of the volcanic Cascade Range is near the northern border of the county; the western half of the county is part of the Great Valley; and the eastern half is within the northern Sierra Nevada. The rocks of Butte County may be divided roughly into two major groups and eight sub-groups. The Subjacent or Bedrock series consists largely of metasediments and metavolcanics of pre-Cretaceous age, and serpentine and granitic rocks intrusive into them. The superjacent or overlying series consists of Pleistocene and Recent alluvium; late Tertiary volcanics (chiefly basalt and andesite); early Tertiary sediments; and Upper Cretaceous sediments. Rocks of the superjacent series lie unconformably upon the folded bedrock surface.

An areal view of the Great Valley in Butte County presents, for the most part, exposures of Pleistocene and Recent alluvium, but narrow outcroppings of the underlying Cretaceous and Eocene sediments are exposed along major water courses at the eastern edge of the valley where they lap up onto the tilted bedrock surface of the main mass of the Sierras.

In the Sierran foothills, the bedrock metavolcanic greenstones and the metasediments have a roughly NW-SE trend, the structure being disrupted in many places by large intrusions of serpentine and still larger ones of granitic rocks. An excellent section of basement rocks is exposed along the North Fork of the Feather River. Leaving Oroville, Highway 24 passes successively through a broad belt of metavolcanic greenstones, then Calaveras (?) slate, a small body of serpentine, more greenstone, a large body of serpentine, and finally into granodiorite. Small limestone lenses appear in the metasediments at some points.

Andesites and basalts of the Cascade province cover the bedrock in the extreme northeast part of Butte County and rhyolite tuff of the Pliocene Tuscan formation underlies the volcanics at some points. The Tuscan formation interdigitates with the sediments of the Tehama formation under the Great Valley.

Strike faulting, largely of thrust type, disrupts the bedrock structures in some parts of the county, but to date no great system such as is known in the Mother Lode region has been described in the northern Sierra Nevada. Normal faults have been described cutting the Tertiary and Quaternary volcanics.

Mineral Resources

The principal mineral resources of Butte County are gold, miscellaneous stone, and crystalline limestone. The first two were mined in considerable quantity during the year. Limestone reserves, although large and of a quality suitable for processed lime and portland cement, were not exploited during 1947. Substantial quantities of lead, zinc, copper, chromium, and cadmium were mined during wartime, but properties which produced these metals are now idle for the most part. Small quantities of platinum and silver were recovered during this year's operations. Other minor resources of the county in which there is no present activity are brick clay, talc, mineral water, mineral paint, lignite coal, and manganese. A few diamonds of good quality have been taken from placers in Butte County over a long term of years.

Mining Activities During 1947

The most productive single operation in Butte County, in the mineral industry during 1947, was the Lancha Plana No. 5 gold dredge on Butte Creek. This is a connected-bucket dredge having 65 4½ cu. ft. buckets, electrically powered. Such dredges are capable of digging 80 to 100 feet below the water line. Other large dredging operations were Yuba Consolidated Goldfields Butte Unit dredges; the Gold Hill Dredging Company's Kister dredge; Placer Exploration Company's Drescher Ranch dragline; Vasco Mining Company's Big Hill dredge; and Hoosier Gulch Placer's Boat no. 1 dragline. All of these are in the Oroville district.

Several drift mines produced substantial quantities of gold-bearing gravels during 1947. The largest of these was the Morris Ravine or Split Rock mine in Morris Ravine, 3 miles northeast of Oroville. This operation is unique in that a ditch-digging machine was used to recover gravel from a tunnel large enough to admit the entire bulky apparatus. Other drift mines operated during 1947 were the Shawnee in the Butte Creek district and the Dally in the Magalia district.

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The Surcease mine, a lode property 7 miles northwest of Yankee Hill, was operated by the Hoefling Brothers until April 1947, but since has closed down. Other lode mines reporting production for 1947 were the Wyoming in the Magalia district and the Monte at Understook.

The two largest producers of rock products in Butte County are the Henry J. Kaiser Rock Products Company on the main highway between Marysville and Oroville, and the Butte Creek Rock Company located on the Centerville Road east of Chico. The latter has greatly increased its crushing plant in the last two years from a former capacity of 1000 tons per day. Both the above plants utilize the enormous piles of rock left by the gold dredges.

Several hundred tons of high grade chrome ore were produced from the Lambert mine in the Magalia district by Helmke, Thomas, and Janssen.

Mineral Production in 1947

Product	Quantity	Value
Chromite------------------------------	308 short tons	(2)
Gold----------------------------------	27,037 troy ozs.	$946,295
Sand and gravel-----------------------	55,643 short tons	57,123
Silver--------------------------------	2,201 troy ozs	1,992
Unapportioned (chromite, natural gas, crude platinum metals, and stone)---	-----	306,000
		$1,311,410

(2) Value included with "Unapportioned".

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MINERAL INFORMATION SERVICE

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MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

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NEW PUBLICATIONS OF THE DIVISION OF MINES

Bulletin 141, Geologic Guidebook Along Highway 49

The second printing of Bulletin 141, Geologic Guidebook Along Highway 49, is now being distributed. The first edition was exhausted within 2½ months of the initial distribution date and there has been no abatement in demand since the new supply became available. First in a scheduled series of guidebooks, Bulletin 141 is a semi-technical treatise prepared to inform the traveler on the principal points of geological, historical, and cultural interest. Mines, minerals, rocks, and historic structures are described and their background is discussed. A complete review of the contents of the book appeared in January 1949 MINERAL INFORMATION SERVICE.

Bulletin 144, Copper in California

This book is prepared under the direction of Olaf P. Jenkins, with the cooperation of the Geological Survey, United States Department of the Interior, Bureau of Mines, United States Department of the Interior, and the Department of Mining, Stanford University, and is based on strategic-mineral investigations conducted during the period of World War II.

The volume is divided into three parts. PART 1, Detailed Reports on the Foothill Copper Belt, is devoted to the strategic-mineral investigations and is accompanied by numerous geologic maps to be found in the map pocket; PART 2, Economics and Treatment of Ores, discusses the marketing and metallurgy of California's complex copper-bearing ores; and PART 3, Statewide Tabulation of Copper Properties to Accompany Economic Mineral Map of California No. 6, discusses the general geology of the districts and economics of production. It provides an exhaustive tabulated list and bibliography covering all the copper occurrences reported in California (some 1,700 localities), the distribution of which together with other pertinent data are shown on the accompanying state map folded in the map pocket.

Bulletin 144 contains "Foothill Copper-Zinc Belt of the Sierra Nevada, California," by George R. Heyl, "Zinc-Copper Deposits of the Big Bend Mine, Butte County, California," by John H. Eric, "Geology of the Lilyama and Pioneer Mines, El Dorado County, California," by Manning W. Cox, Donald C. Wyant, and George R. Heyl, "Newton Copper Mine, Amador County, California," by George R. Heyl and John H. Eric, "The Grayhouse Area, Amador County, California," by George R. Heyl, "Ore Deposits of Copperopolis, Calaveras County, California," by George R. Heyl, "The Zinc-Copper Mines of the Quail Hill Area, Calaveras County, California," by George R. Heyl, "La Victoria Copper Mine, Mariposa County, California," by Manning W. Cox and Donald G. Wyant, "Zinc Deposits of the American Eagle-Blue Moon Area, Mariposa County, California," by John H. Eric and Manning W. Cox, "The Jesse Belle Copper Mine, Madera County, California," by Manning W. Cox and Donald G. Wyant, "The Marketing and Metallurgy of Complex Ores in California," by Hadley R. Bramel, and "Tabulation of Copper Deposits of California," by John H. Eric.

Bulletin 144 is well illustrated with 9 pages of photographs and 52 plates folded in a separate box which accompanies the book: these include index maps of mines, geologic level maps, sections and vertical projections, composite maps, and a large outline geologic map of California showing locations of copper properties scale 1:1,000,000.

California Journal of Mines and Geology, Vol. 45, No. 2, April 1949

This volume includes "Water-Flooding as a Method of Increasing California Oil Production - Part 1," by Wilbur H. Somerton, which is the culmination of extensive research on the secondary recovery of oil with particular emphasis on increasing California recovery. As very little scientific effort has been directed toward the study of the peculiar conditions presented in the California fields Mr. Somerton's paper is especially applicable. This paper is being presented in three parts; Part 2 is now in press and will be printed in the July issue of the California Journal of Mines and Geology.

"Mineral Resources of Kern County," by W.B. Tucker, R. J. Sampson, and G.B. Oakeshott gives an accounting of the tremendous mineral resources of Kern County. Not only is Kern County known as the largest producer of oil and gas in the state, but it also has distributed deposits of antimony, arsenic, copper, gold-silver ores, lead and lead-zinc ores, tungsten, tin, tincal (borax), kernite (rasorite), cement, alluvial clay for the manufacture of brick, feldspar, gypsum, perlite, pumice, and volcanic ash (pumicite).

"State Geological Survey," by Wilson M. Laird, is a reprint of a publication from The American Year Book, 1948. It is a summary of the scope and activities of each Geological Survey by State as to its organization, basic and economic geology, water resources, and publications.

Oliver Bowles and Nan C. Jensen's paper on "Industrial Uses of Limestone and Dolomite," is reprinted from Bureau of Mines Information Circular 7402. The presence of limestone and dolomite is of vast economic importance, because they are used much more extensively than any other form of rock. This work discusses the industrial and chemical uses that are less widely known and yet are of tremendous importance in a great variety of processing industries.

Because of the great interest in atomic energy, "An Act For the Development and Control of Atomic Energy," which is a copy of a paper put out by the Atomic Energy Commission, is also included in this Journal.

MINING AND INDUSTRIAL NEWS NOTES

Cuyama Valley Oil Discovery

A new major field has been discovered 5½ miles east of the present Cuyama (Russell Ranch) field located a year ago. Both areas were developed by the Richfield Oil Company. The discovery well, which was brought into production May 4th, came in at the rate of 5088 barrels of 34 gravity oil and 1,500,000 cubic feet of gas per day. Production is from lower Miocene sands and the structural trap is the result of faulting. The reservoir sand is similar to that of Russell Ranch and White Rock and over 300 feet of permeable oil sand was cored lying between 4100 and 4392 feet.

Gold Dredging in Trinity County

Gold dredging is proceeding on the East Fork of Stewart's Fork about 3 miles north of Minersville on the Nugget Placer owned by L.A. Grange of San Mateo. Gravel is believed to be at the intersection of two old river channels and is estimated to be fifteen feet deep. It is composed of pebbles and cobbles but no troublesome boulders. Bedrock is black slate.

About 5 feet of overburden is stripped from the gravel with a P. & H. dragline and a D-7 Caterpillar bulldozer. The dragline is equipped with a D-13,000 Caterpillar diesel engine, boom 55 feet long, and a 1¼-cubic yard bucket. The outfit was formerly Dredge No. 1 of Thompson Divide Mining Company for which O.A. Herbert was formerly dredgemaster in charge of Dredge No. 2, which was operated on the Trinity River a mile above Lewiston. Herbert is leasing the outfit now in use north of Minersville and is conducting operations on one shift with only one employee, a dragline operator. This is one of only two dragline dredging operations now being conducted in the northern counties of the State.

MATERIALS OF MINERAL ORIGIN USED IN THE RUBBER INDUSTRY

The Firestone Tire & Rubber Company
by Erle C. Zimmerman

A large variety of materials are used in the compounding of natural and synthetic rubber. These materials fall into two general classes, viz: "Organic" and "Inorganic", the latter being of mineral origin.

The organic materials include the accelerators of vulcanizations, age resistors, plastic resins, oils, waxes, asphalts, pitches, dyes and solvents, most of which have their source in coal tar or petroleum. The various types of carbon black used extensively by the rubber industry also fall into the class of organic materials and have their origin in petroleum and in natural gas.

Most of the materials of mineral origin are manufactured by methods involving chemical processes and are highly refined, purified, and produced in a fine state of particle size. Falling into this category are such materials as blanc fixe, precipitated calcium carbonate, basic magnesium carbonate, precipitated calcium silicate, precipitated silica, titanium dioxide, and zinc oxide. Other materials of mineral origin consist of the finely ground minerals such as talc, limestone, and mica. Still others such as clay and ochre occur naturally in a fine state of subdivision and may require only the removal of coarse impurities.

All of the materials used in the compounding of rubber must meet rather exacting specifications for purity and fineness and in many cases color is also important. Uniformity is desirable and necessary. The more important things emphasized in these specifications are as follows:

PURITY - The degree of pureness or the amount of impurities present in a given material may vary considerably, depending upon the source of the material, the process used in its preparation, and the care exercised in its production. Three types of impurities are encountered as follows:

(A) Those which are harmful in rubber compounds and which will tend to cause deterioration in rubber products.
(B) Those which will degrade the color of a colored rubber article.
(C) Also those impurities which are inert and have no harmful effect on rubber products.

The dangerous impurities which come in the type (A) class are copper and manganese which, in many cases, must not be present in amounts exceeding a few thousandths of one percent. The presence of arsenic is undesirable, and materials showing radioactivity may be questionable. The presence of free acid or alkali must be avoided or at least kept to a safe minimum.

In the type (B) class, the chief concerns are lead, iron, cobalt, antimony, and other elements which have colored oxides or sulfides.

In the type (C) classification are such impurities as the oxides of aluminum, calcium, magnesium, barium, iron, titanium, and silicon, or possibly carbonates or sulfates of calcium, barium, and magnesium. A small amount of lead in the form of lead sulfate or lead oxide may not even be considered harmful in most cases. Zinc and cadmium also may be present in the form of oxides, carbonates, or sulfides.

FINENESS - Rubber compounding materials must be produced in a fine state of subdivision, and air separated, levigated, hydro-classified, or otherwise treated to eliminate the objectionable coarse particles. The necessary fineness will vary, depending upon the nature of the material, the process or production method, and the specific use for which the material is employed.

In most cases, at least 95 percent of the material must pass through a 300-mesh screen, but in other cases 99½ percent must pass through a 325-mesh screen. In either case the bulk of the particles will be of diameters many times smaller than the meshes in a 325-mesh screen.

Coarse residues, even when present in small amounts, are objectionable in rubber compounding, hence almost without exception 100 percent of a material for use in rubber should pass through a 100-mesh screen and in some cases, 100 percent should pass through a 200-mesh screen.

COLOR - If a material is to serve the purpose of a pigment for rubber, its purity must be carefully controlled, and special attention given to limiting the percentages of certain impurities which will influence the color. This is especially true in the case of white pigments such as titanium dioxide, lithopone, and zinc oxides. The covering power of all pigments is important and must be controlled.

A list of 32 of the most common materials of mineral origin used in the compounding of rubber is given below, and a further description of each will be published in the California Journal of Mines and Geology for October 1949. This description will include the source, process, degree of purity required and the necessary fineness, as well as the purpose for which the material is used. Mention will also be made in regard to the extent of the use of each of the 32 materials expressed as large, moderate, or small.

It should be pointed out, however, that carbon black made from natural gas and petroleum is the material most extensively used in the compounding of natural and synthetic rubbers. There are some dozen different types and kinds of carbon black made by various processes which are used in the rubber industry. Nearly all of these carbon blacks are used as reinforcing fillers and are far superior in this respect to any of the materials of mineral origin. In the tire industry, for instance, three pounds of carbon blacks are used to one pound of the combined total of all of the 32 materials of mineral origin listed. The ratio is lower than this for mechanical goods.

Materials of Mineral Origin Used in the Rubber Industry

(1) Asbestine
(2) Barytes
(3) Blanc Fixe
(4) Brown Oxides of Iron
(5) Cadmium Yellow
(6) Calcium Carbonate, Precipitated
(7) Calcium Carbonate, Ground
(8) Calcium Silicate
(9) China Clay (Kaolin)
(10) Clay (Rubber Clay)
(11) Diatomaceous Silica
(12) Hydrated Lime
(13) Lithopone
(14) Litharge
(15) Magnesium Carbonate, Basic
(16) Magnesia, Calcined
(17) Mica
(18) Ochre
(19) Red Lead
(20) Red Oxide of Iron
(21) Selenium
(22) Silica
(23) Sulfur
(24) Talc
(25) Tellurium
(26) Titanium Dioxide
(27) Ultramarine Blue
(28) Zinc Oxide, French Process
(29) Zinc Oxide, American Process
(30) Zinc Carbonate
(31) Zinc Sulfide
(32) Zinc Yellow

CALAVERAS COUNTY

Geologic Features

Calaveras County is situated principally in the Sierra Nevada mountain chain although the extreme northwestern portion lies close to the Great Valley. The county extends across the Sierras almost at right angles to their structural trend. Hence, the structural and stratigraphic sequence in Calaveras County is a fair cross section of the central Sierra Nevada as a whole. The geologic formations of the central Sierra have been conveniently divided into two major groups known as the subjacent or Bedrock series and the Superjacent or overlying series. The latter lies unconformably upon the former, where present, and has not been subjected to the severe folding or orogenesis as has the subjacent series.

The county can be divided into three areas on the basis of the bedrock lithology. The northeast quarter of it is made up mainly of granitic rocks of Upper Jurassic age with erosional remnants of Tertiary volcanics resting on them. The central half of the county consists principally of complexly folded and faulted metamorphic rocks assigned to the Calaveras formation. Slate, schist, phyllite, quartzite, argillite, crystalline limestone, and greenstone members are known in the Calaveras. Granitic rocks of great extent invade the formation in many places, and less extensive intrusions of ultra-basic rocks such as peridotite (serpentinized) and pyroxenite are common. The general structural trend of the folded bedrock is NW-SE but the central part of the county lacks the belted arrangement of the rocks of the western quarter. West of the Mother Lode, Calaveras and Amador group rocks outcrop in alternating bands owing to tight isoclinal folding accompanied by faulting. The Mother Lode itself is a major structural feature of such magnitude that thousands of feet of strata are cut out by the faulting at various places along its 120 mile length. The system passes through Calaveras County in a northwesterly direction from Carson Hill on the Stanislaus River to Middle Bar on the Mokelumne River.

Another mineralized zone controlled largely by thrust faults more or less parallels the Mother Lode eight or ten miles to the west of it. The copper camps of Copperopolis, Campo Seco, and several others comprise the foothill copper belt of the Sierras, a mineral province almost as well known as the Mother Lode, though not nearly so productive. Substantial amounts of copper were produced along the belt during both world wars but copper mining is now at low ebb.

In the Superjacent series of Calaveras County, the early Tertiary gravel channels at the base of the series have been of major economic importance. They formed during the erosion of the upper parts of the gold lodes and consequently contain concentrations of placer gold. Later, rapid burial by Mid-Tertiary pyroclastic and further additions of later Tertiary flow lavas preserved parts of the old river channels from the erosion period that followed. However, unexposed parts must now be exploited by tunneling under the volcanic cap-rocks. The old river systems somewhat resembled the present stream systems in general distribution, but the mountain relief was far less than exists today. The climate was subtropical, and chemical weathering was very pronounced. This type of weathering was responsible for the large scale decay of the gold lodes and for the formation of valuable deposits of quartz sand and clay.

Mineral Resources

Gold lodes and auriferous placers still form the principal mineral wealth of Calaveras County. Owing to current labor conditions and high operation costs only a few of the many deposits are now being exploited. Most of the recent mining activity has been in the West Point, Angels Camp, and Copperopolis districts. Copper reserves are in much the same status as gold. Large tonnages of low grade sulfide copper ores still remain in the foothill copper belt.

Heavy production of zinc and lead from the Campo Seco district was reported through the war years but zinc production virtually ceased there in July 1947 when the Penn mine closed down. Substantial reserves of zinc-lead copper ore still remain in the Campo Seco district.

Millions of tons of limestone suitable for Portland cement and processed lime occur within the county boundaries. The limestone industry of Calaveras County already includes one of the large Portland cement plants of the state. Numerous deposits are idle which might be developed.

A high-iron clay suitable for ceramic shapes such as terra cotta pipe is mined in the vicinity of Valley Springs. Reserves in that part of the county are large. The clay is a high-strength type used for mixing with clays of other characteristics in ceramic batches. Clay shale is also mined in the Valley Springs district for similar purposes.

Several of the ancient channel-gravel deposits contain quartz crystals suitable for use in electronic devices. Several hundred pounds were mined for that purpose near Mokelumne Hill during the late war. Some crystals weighed more than 100 pounds. The deposits are by no means exhausted. Channel gravels are also an almost unlimited source of stone for processing into aggregate and road metal.

Small deposits of talc occur along the Mother Lode as hydrothermally altered parts of serpentine bodies. This material was once extensively mined and dressed for building facings. Another material widely used as building blocks, dressed stone, etc., is the indurated rhyolite tuff of the Valley Springs formation. This material is also suitable for crushing to aggregate or road metal.

Mining Activities During 1947

The largest single operation in the county during 1947 was Calaveras Cement Company's Portland Cement plant at Kentucky House near San Andreas. Recent improvements and additions to the plant have increased its capacity to 7500 barrels per day. New equipment includes two 87 Marcy mills and two 8 x 22 bobtailed rake-classifiers in the raw-grinding department; three 48-inch Telsmith cone crushers for secondary grinding; a new 10-ton crane for handling rock in raw storage; two 86 Marcy mills for finish grinding; and an increased truck fleet for hauling rock and cement. The increased plant capacity required new assurances of sufficient long-time limestone reserves so an extensive diamond-drilling program was undertaken at No. 4 quarry. The program required 10 months to complete and more than 6000 feet of holes were drilled. Sufficient high grade limestone was developed to furnish raw material for full capacity production for a long period of time. In addition, the drill cores outlined lenses of schists of different compositions which are particularly adaptable to the manufacture of the special cements now demanded by the market. The road to No. 4 quarry has been widened and improved to handle the increased traffic. Calaveras Cement Company employs about 275 men at the plant.

The principal producing gold mines in Calaveras County were the Mountain King mine northwest of Copperopolis, the Centennial mine at West Point, the Penn Mine at Campo Seco, and the Cuneo property on San Antonio Creek. Small intermittent production of both lode and placer type was reported from widely scattered points such as Linden, Camanche, Angels Camp, Altaville, Natoma, Waupt Creek, Railroad Flat, Glencoe, and Murphys. At Campo Seco, the Shawmut Copper Mining Company operated the Penn mine until July and produced considerable gold and some silver as by-products in the recovery of zinc, lead, and copper. The ore was processed at the Eagle Shawmut mill, and gold and silver-bearing pyrite concentrate was shipped. Lead was also a by-product of the ores in which the dominant metals are zinc and copper. Mining was carried on from the No. 2 and No. 3 shafts with most of the ore coming from above the 1400 foot level. The operators were H.C. Mueller and George W. Clemson of Chinese Camp; D.C. Peacock superintended the operation. The Mountain King Mill and Mine Company of Fresno operated the Mountain King mine through 1947. This mine was one of the three largest producers in the county. The vein is at the contact of Mariposa slate and Logtown Ridge greenstone; it trends N. 32° W. with northeastward dips varying from 25° to 30°. Considerable quantities of ore were found in hydrothermally altered greenstone adjoining the vein.

The Centennial mine at West Point (formerly the New Champion) was operated through most of the year under the management of M.G. O'Hanlon and Son. It is one of the few gold mines which has been operated continuously over a period of several years. Development is progressing through a 200 foot inclined shaft and drifts along the strike of the vein. The strike of the ore body trends N. 8° to 10° W; it dips about 60° W; pitches south at a low angle; and has been exposed for a distance of 175 feet along the strike. The ore shoot is composed of pyrite, galena, and free gold in a quartz gangue. Both wall rocks are granodiorite. Average gold recovery has been in excess of $50.00 per ton with recovery averaging more than 90 percent. The mill and hoisting equipment have been completely overhauled and considerable new equipment added.

The California Pottery Company continued to produce high-strength high-iron clay at its quarries near Valley Springs. The clay is shipped to the company plant at Niles, California where it is added to ceramic batches for sewerpipe and other fired clay products. Brownlite Products continued to produce volcanic ash for use as lightweight aggregate from quarries near Valley Springs.

Mineral Production in 1947

Product	Quantity	Value
Copper	1,242,000 pounds	$260,820
Gold	5,171 troy ozs.	180,985
Lead	90 short tons	25,920
Silver	97,076 troy ozs.	87,854
Zinc	2,350 short tons	568,700
Unapportioned (cement, raw clay, pumice, sand and gravel, and stone)	-------	3,075,042
Total value	-------	$4,199,321

MINERAL PIGMENTS

The use of mineral pigments and natural colored materials dates back to ancient and primitive man as found in their works of art and colored drawings in caves. From this early use of colors as provided by natural pigments, there has developed a large industry which produces a great array of coloring products from natural and synthetic materials. The mineral pigments of today which provide color, opacity, or body to paint, stucco, cement, linoleum, rubber, and similar products are grouped into the natural mineral pigments and artificial or chemical mineral pigments. The latter class includes those made directly from ores, such as burnt sienna, umber, and zinc oxide, and those manufactured from inorganic pigments, such as white lead, red and yellow iron oxides, Venetian red, Prussian blue and lithopone. Combinations of the two classes are common. Laboratory research has developed many pigments which have displaced to a large extent many of the natural pigments.

The properties of the natural mineral pigments include color, particle size, specific gravity, and hardness. Of these, color is the most important, since high-grade pigments must possess a clear, uniform, bright color resembling one of the standard colors now in use. The essential color constituents of the natural pigments are commonly one or both of the iron oxides limonite ($Fe_2O_3.xH_2O$) and hematite (Fe_2O_3). Magnetite (Fe_3O_4) rarely is present. Since these oxides are end products of weathering, they are found to be stable during their use. Particle size of the pigment is important from the standpoint of oil absorption, opacity, and hiding power. Natural pigments will range from slightly less than one micron to two and one-quarter microns. The specific gravity and hardness will vary in accordance with the mineral composition and the variable physical properties of the particular deposit. The base of the pigment is usually clay and silica in addition to the coloring oxides. Since the natural earth pigments are used for a variety of purposes, each of which has its particular requirements, the value of the material in question can be determined best by practical tests by the possible consumer.

Yellow ocher is the important natural mineral yellow and consists of yellow-brown limonite containing 17% or more of Fe_2O_3 and varying amounts of clay, silica, and other impurities. Sienna and ocher are similar with no great difference in the iron oxide content or color. The siennas grade into average ocher with lower iron content and into umber with increasing manganese oxide content. Burnt sienna, which has part of the water of hydration driven off, is light yellow to deep reddish-brown in color. Red iron oxide pigment is largely hematite with a Fe_2O_3 content of at least 60 percent. Foreign red oxides on the average are higher grade than the domestic ones but a domestic deposit containing 80 percent or more Fe_2O_3 with a deep color in oil and low calcium carbonate content would probably find a ready market for paint pigments and other uses. The important brown mineral pigment is raw metallic brown or mineral brown (limonite and siderite iron ores). The raw ore is calcined to produce the finished product. Crude ore ranges from 65 to 72 percent Fe_2O_3. Umbers are greenish-brown as a raw material with 45 to 50 percent Fe_2O_3 and 8 to 15 percent manganese oxide. Black iron oxide pigment is magnetite which analyzes 90 to 95 percent Fe_2O_4. Natural green pigment called terre verte or green earth consists principally of glauconite, with the iron silicate content contributing the green color. Impure graphite, such as a mixture of graphite and silica, can be mixed with iron oxide and zinc compounds to produce a suitable black pigment. White clays, talc, dolomite, gypsum, barite and other natural white minerals are used mainly as fillers and extenders since they cannot equal the opacity of white lead, zinc oxide, lithopone, and titanium oxide in white paints. During World War II, a large amount of cheaply mined, coarsely ground mineral pigments such as slate, quartz, and sub-standard ochers were used in large quantities for camouflaging purposes, particularly in England.

In normal times the iron oxide pigments are used for low-priced paints, linoleum, mortar colors, chicken feed, and glass polishing. A large amount of red pigment was consumed immediately after the recent war for barn and freight car paints. Iron oxide paints are used for iron and steel protective coating, competing with graphite and red lead paints. Iron oxide pigments are also used as coloring agents and fillers in the manufacture of imitation leather, shade cloth, shingle stain, cardboard, and paper filler. Siennas and umbers are used for wood stains and fillers. A fair amount of umber is consumed by the wallpaper industry and in furniture paints and stains. Ocher, toned with dyes, is used for linoleum and oilcloth, wood stains and for coloring cement, stuccos, and mortar. The consumption of natural mineral pigments has declined to about 10 percent of its volume in the nineteen twenties.

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The occurrence of the natural mineral pigments is often associated with iron deposits which would be expected from their chemical composition. Replacement and precipitation deposits are the principal sources of limonite and ocher deposits. During weathering of impure limestones, sandstones, and shales, ground waters charged with iron salts deposit the pigment minerals in seams and cavities. Important deposits are found in fractured and faulted zones of rocks of many different geologic ages. The ocher in the noted Cartersville, Georgia, district is found in pockets and irregular seams in fractured quartzite. The chief production of ocher, sienna, and umber in the United States is from Georgia and Pennsylvania. California, New York, Illinois, Tennessee, Virginia, New Jersey, and Ohio produce small amounts. In California, 15 counties have produced natural mineral pigments, while deposits have been reported from 24 counties. Total production of mineral pigments in California from 1890-1946 amounted to 25,933 tons valued at $249,038. San Bernardino County, with one active operator, was the only producer in the state in 1946.

Preparation of mineral pigments for the market is by simple washing, dehydration, and pulverizing. Log washers and blungers are used for breaking up the material, which is then dehydrated by different types of classifiers, settling tanks and filter presses. The material is then pulverized in hammer type pulverizers for sizing and packed for shipment.

The field of artificial and chemical pigments is an extensive one. Calcined or roasted natural pigments were the earliest of such materials. Iron ores are used to produce the iron oxides. Red, yellow, brown, and black pigments are produced from iron salts. Artificial brown pigments are a product of calcined siennas, umbers, and limonite. Lead compounds used as pigments are the red oxide, orange and yellow lead chromates, yellow massicot, orange litharge, and white basic carbonate. Chromium oxide is used to obtain red, yellow, and orange pigments. Blue pigments are made from melted cobalt silicate. Most white pigments contain white lead, zinc oxide, lithopone or titanium oxide.

Prices quoted by Engineering and Mining Journal Metal and Mineral Markets for Georgia ocher is $24.00 per ton, f.o.b. mines. Dark yellow Virginia ocher (60% ferric oxide) is quoted at $22.50 per ton and domestic earth iron oxide at 3 to 5 cents per pound.

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MINERAL INFORMATION SERVICE

VOL. 2 July 1, 1949 No. 7

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

NEW PUBLICATIONS OF THE DIVISION OF MINES

The most recent list of available publications of the California State Division of Mines is now being distributed. It is revised to May 1, 1949, and supersedes all previous lists. The last list, which included publications to September 1, 1948, was distributed last October. Copies of the new list may be procured without cost upon request from the San Francisco office or from the several branch offices of the Division located at Los Angeles, Sacramento, and Redding.

MINING AND INDUSTRIAL NEWS NOTES

Gold Operation in Los Angeles County

Some very high-grade gold ore has been found in the quartz vein of the Hi-Grade mine. This vein, ranging from a few inches to 2 feet in width, occurs in the quartz diorite country rock of the area. It has been opened to a depth of 200 feet and for about 150 feet along its strike. In places it is partly filled with copper sulphides, with which gold is associated. On the property, through a width of some 1500 feet, is a series of six or eight roughly parallel veins; some development work was done on these many years ago. In the canyon to the south are the ruins of several arrastres in which the gold was extracted by these early-day operators.

The Hi-Grade mine (formerly known as the Don) in Los Angeles County is being developed by Francis Gage of 1557 South Fairfax Ave., Los Angeles. The property is in Mint Canyon some two miles southwest of the Governor mine, which Gage reopened in 1932, and from which he produced about $1,600,000 in gold, more than half of the recorded production from this county. The Governor mine was originally worked by Gage's father, who was once governor of California.

While concentrating for the present on development work, Gage has erected at the shaft a mill for treating the ore. Mill equipment consists of a jaw crusher, ball mill, classifier, and plates. A concentrating table will be added in the immediate future. Capacity of the mill is about 12 tons per day.

New Ore Treatment Plant Near Saugus, Los Angeles County

The Metrecore, Ltd. is to operate the new ore processing plant now nearing completion near Honby Siding on the Southern Pacific Railroad about 3 miles northeast of Saugus, California. The plant has been built on the terraced hillside south of the railroad and is, therefore, ideally situated for gravity flow of all plant operations. Silver ore for processing at this plant is to be shipped in from several Kern County properties known as the Gold Cross and Standard groups leased by the Mineral & By-Products, Ltd. A description of these properties was printed in the April 1949 issue of the California Journal of Mines and Geology.

The ore reduction system to be used in the plant is a hydro-metallurgical process of controlled leaching to produce crystallized mineral salts for agricultural uses.

Placer Mining in Trinity County

An electric power line has been completed to the site of the Fairview Placers on the west bank of Stuart Fork near its junction with the Trinity River, about a mile below Minersville in Trinity County.

The Fairview Placers purchased the bucket-line dredge from the Junction City Mining Company and moved it to the present site where it is being re-assembled. Additional pontoons are being added to the hull to make a barge 136 feet long and 62 feet wide. The digging ladder is being lengthened 8 feet and it will be driven by "V" belts. A separate motor is being installed for the ladder hoist. The sluice boxes with Hungarian riffles used to recover the gold and platinum at Junction City are being replaced with Yuba jigs.

The gravel is about 25 feet deep, and bedrock is schist. There is some cement gravel but few boulders in the stream.

Mr. H.B. Murphy is manager in charge of Fairview Placers, and H.C. Young is general superintendent.

TOPOGRAPHIC MAP INDEX

Included in the back of the July issue of California Journal of Mines and Geology is the most recently revised index to the topographic maps of California available or in process of publication by the U.S. Geological Survey. Overprinted on an outline map of the State of California are the names and locations of all available topographic quadrangle maps made by the Survey including certain incomplete planimetric, or advance sheets. An explanatory text is printed on the back of the map. Owing to the great demand for California topographic maps and the stream of inquiries received by the Division concerning such maps, we are including for readers of the Journal this progress map which was originally printed by the U.S. Geological Survey.

REFERENCE LIST OF RECENT PUBLICATIONS

The references listed below are available for study in the Library of the Division of Mines but are not on sale by the Division.

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Aultman, William W., Freshwater from salt: Eng. and Sci. Monthly, vol. 12, no. 5, pp. 3-7, February 1949. Discussion of possibilities of quantity production of potable water from sea water for use in crowded Pacific Coast areas.

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Gillully, James, Distribution of mountain building in geologic time: Geol. Soc. America Bull., vol. 60, pp. 561-590, April 1949. Contains much information on the Tertiary tectonic record in California.

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Myers, J.F., et al, Minerals beneficiation of annual review: Min. Eng., vol. 1, no. 3, pp. 66-71, March 1949. A summary of present and probable future trends in ore beneficiation.

Wallace, Robert E., Portion of the San Andreas rift in southern California: Geol. Soc. America Bull., vol. 60, no. 4, pp. 781-806, 3 plates, 3 figs., April 1949. Discusses the geology and fault movements along the San Andreas rift between Palmdale and Elisabeth Lake.

ALUM AND ALUM MINERALS

The true alums comprise a series of hydrous double sulphates isomorphous with common alum (potassium aluminum sulphate) in which the potassium may be replaced by a monovalent metal such as sodium or a radical such as ammonium and the aluminum replaced by iron, chromium, or other trivalent metal. The alums are all water soluble, give an acid reaction in solution, and lose their water of crystallization when heated. They have a characteristic taste, being first slightly sweet then definitely sour with a strong astringent action. There are several native alums but all occur sparingly. Kalinite is the common or potassium alum. Mendozite is soda alum and tschermigite is ammonium alum. Others are halotrichite, iron alum; apjohnite, manganese alum; and pickeringite, magnesium alum.

Kalinite, $K_2SO_4.Al_2(SO_4)_3.24H_2O$, is a colorless or white mineral with a white streak and vitreous luster. Its hardness is 2 to 2.5 and specific gravity 1.75. The other alums are similar in physical characteristics. Their color can range from white through pale yellow, green, and pink.

Two other minerals which are not true alums but which are closely related are alunogen, a hydrous aluminum sulphate, and alunite, a hydrous sulphate of potassium and aluminum.

Alunogen, $Al_2(SO_4)_3.18H_2O$, is white, yellow, or reddish in color with a white streak and vitreous luster. It has a hardness of 1.5 to 2 and a specific gravity of 1.6 to 1.8.

Alunite, $Al_2(SO_4)_3.K_2SO_4.4Al(OH)_3$, sometimes called alumstone or alum rock, is white in color and streak with a vitreous to pearly luster. It has a hardness of 3.5 to 4 and a specific gravity of 2.58 to 2.75. Alunite is an alteration product of feldspathic rocks, probably brought about by the action of sulphurous vapors. It occurs disseminated through altered prophyritic volcanic rocks such as rhyolites, trachytes, and andesites. Sometimes it is found as definite veins such as occur at Marysvale, Utah.

The natural alums are all readily water soluble and so normally are not found in quantity except in arid regions or in protected places such as caves. Most of them occur as efflorescences or fibrous incrustations, almost asbestiform but sometimes powdery or massive, on shales, schists, and even volcanic rocks. Many shales and schists contain pyrite and marcasite plus easily alterable aluminous minerals. The oxidation of the sulphides upon weathering produces sulphuric acid which acts upon the aluminous material to produce alums. These alums dissolved in circulating waters, or in waters moving through capillary openings, are re-precipitated as efflorescences or fibrous crusts. Some alum minerals and those closely akin, such as alunogen, can be formed directly as a sublimation from volcanic action. The formation of the alums is very local in nature and none of these minerals are found far from their point of origin.

Kalinite has been found in Esmeralda County, Nevada, as an irregular network of small veins associated with sulphur in rhyolite. The rhyolite itself is highly altered and contains disseminated alum. Alunite and alunogen both occur in California and some production was made from an alunogen deposit in Riverside County in 1938.

Alum has been known and used since ancient times. The Egyptians, Greeks, and Romans noted its use as a mordant or fixing agent for the production of dyes of bright colors. It was introduced in Europe in the 13th Century, and in 1460, alum production was started near Civitavecchia, Italy, and was an important product in that district up to recent times. The alum here produced was of high purity and became known as Roman alum. Alunite was probably the ore used for this production.

Biringuccio, writing in 1540 (Reference No. 6) stated, "......I tell you that the alum that is commonly called rock alum today is a congealed earthy substance, clear and transparent, of a hot and dry nature, and of a bitter taste with a certain unctuous saltiness. It has an astringent and corrosive property and is drawn from mineral stones by means of art"... ".....Alchemists and parters make great use of it; indeed without it they could not make their acids nor could the dyers of cloth and wool work without it, for alum is as necessary to them as bread to men. It is also used for tanning raw leather and in medicine for various illnesses."

The natural weathering in place of shales and schists is too slow to produce considerable alum. To accelerate this process, these materials were mined, crushed, and spread out in thin piles or roasted to oxidize the sulphides and liberate free sulphuric acid. The alum produced could then be recovered by solution in water and subsequent evaporation. Thus clays, shales, and schists were an important source of alum in England for more than two centuries.

Other materials which have been utilized in alum manufacture are leucite, cryolite and even certain pyritic lignites. Practically all alums are now made from bauxite, which in broad terms is a mixture of relatively alumina-rich and silica and iron-free materials resulting from weathering of rocks.

The bauxite is ground to 80 percent minus 200 mesh and treated with sulphuric acid (60° Baume) and steam in lead-lined reactor tanks. The resulting aluminum sulphate solution is clarified by precipitation of the iron and concentrated in an evaporator to 59° to 60° Baume. This solution is poured into pans for solidification. To make any of the alums, the sulphate of the monovalent metal is added to the dilute aluminum sulphate solution, which is then concentrated. The final solidified material is broken and crushed to size for shipment.

For most uses of alum, the effective agent is the alumina, and the uses are based principally on the action of the colloidal alumina and other colloids. For this reason aluminum sulphate, which is a cheaper source of alumina, is replacing the various alums. The many uses include water and sewage clarification, tawing of skins to produce white leather, paper sizing, manufacture of lake pigments, in various medical preparations, and in the production of fireproofing materials. The most important single application is in water clarification, wherein the aluminum sulphate is known as water works alum. The "burnt alum" in pharmaceutical preparations is alum which has been heated to drive off the water of crystallization.

Aluminum sulphate is marketed in two grades: iron free, with less than 0.1% iron oxide, and commercial, with more than that amount. The current, February 1949 prices are given as follows:

Commercial grade, in bags, carload lots $1.50 per 100 lbs.
Iron free, in bags, carload lots $2.75 per 100 lbs.

The various true alums range in price from $3.25 per 100 pounds for soda alum in barrels to $4.45 per 100 pounds for powdered potash alum in barrels. Burnt ammonia alum, USP, in barrels is quoted at 16¢ to 18¢ per pound.

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THE HISTORY OF THE AMERICAN SMELTING AND REFINING COMPANY

Metal Magic, The Story of the American Smelting and Refining Company, by Issac F. Marcosson, published by Farrar, Straus and Company Inc., New York.

The author is a former newspaper reporter and was for many years a writer for the Saturaay Evening Post.

The book opens with a series of stories about the part that chance has played in discoveries of mineral deposits. The early history of Myer Guggenheim and his seven sons is described; also his early mining ventures at Leadville, Colorado, and later in Mexico. The names of many other men associated with the early history of American Smelting and Refining Company (ASARCO) are mentioned, including Bernard M. Baruch. The acquisition of the Tacoma copper smelter and the Selby lead smelter is described.

Help given by the Guggenheims in financing the Bingham mine of Utah Copper Company is mentioned; also a report on this mine made under the supervision of Seely W. Mudd Association with Kennecott Copper Corporation and selection of the site of the Garfield smelter are described. By 1915, ASARCO had acquired zinc smelters, a copper refinery, and a tin plant. It is stated to have now 17 plants in 11 states and to extend into Mexico. Operations have been conducted in many other parts of the world.

Extensive Mexican operations are described, including the production of coal, coke, arsenic, lead, zinc, copper, gold, and silver; also troubles experienced with both taxes and bandits.

Recent improvements in smelters and refineries are described, including the building of some very high stacks; also improvements in employee relations including safety measures, pension system, and group life insurance. Many recent and present officials are named, and some of the present policies of the company in such matters as buying ores and acquiring new mining properties are described.

The treatment is biographical and historical rather than technical.

MINERAL NEEDS AND PROBLEMS OF THE FERTILIZER INDUSTRY

by

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The California fertilizer industry has expanded rapidly during the past decade. An even greater consumption of fertilizers would have been experienced but for a shortage of such materials. All indications point to continued expansion in an essential agricultural industry basic to maximum food production in a relatively new state which shows promise of continuing as the outstanding agricultural state in the union. Needless to say, there are additional raw materials which must be discovered and developed if California is to reach a degree of self-sufficiency in supplying fertilizers and agricultural minerals to its farmers and growers. These raw materials should be located in or near to the source of consumption, which is the California farmer and grower. Fertilizers are bulky materials with transportation rates usually higher than warranted when compared with the value of the agricultural crops produced. These crops in turn must be transported long distances to urban areas of consumption.

The annual commercial production and distribution of fertilizer and agricultural minerals in California is now approximately 1,200,000 tons. This does not include farm manures and some other materials of agricultural value which find their way to the soil. Agricultural crops, grown and removed from the land, deplete our naturally fertile soil of plant food by many times that recovered and returned. Some of the older agricultural states in the east are presently returning commercial plant foods somewhat in relation to their removal and by so doing are developing a balanced plant food position.

Primary commercial plant foods, as recognized by the California Department of Agriculture, Bureau of Chemistry, are, nitrogen, phosphorus, and potash. Chemical nitrogen supplies are derived from (1) natural Chilean deposits, (2) by-product ammonia from the coking of coal, and (3) synthetic fixation of nitrogen from the air. It is thus noted that California may not be in the position to discover natural deposit of nitrates, but of course may increase the production of by-product and synthetic nitrogen by building plants for the manufacture of these important fertilizer material

Phosphorus deposits suitable for exploitation by the fertilizer industry are located in Florida, Tennessee, and the western states of Idaho, Montana, Utah, and Wyoming. It is from these latter deposits that phosphate rock has been shipped to California for treatment with sulphuric acid to make superphosphate. Imports of ammonium phosphate from Canada owe the origin of their phosphates to mines in Montana. There is a need for high-grade phosphate-bearing ore located near the superphosphate-producing areas such as San Francisco and Los Angeles. In other words, transportation costs could be greatly reduced provided a high grade phosphate rock deposit were to be uncovered in or near California.

New regulations covering exploration, development, and production of western public lands containing phosphate rock were reported by Assistant Secretary of the Interior C. Girard Davidson. Under the new arrangement, fertilizer output in the west may be increased to a considerable extent and expecially if high grade deposits could be located nearer to the West Coast. A new type of development lease provides for exploration and discovery of phosphate deposits in unexplored areas of the public land. More detailed information can be secured from the Department of the Interior, Washington, D.C.

Large quantities of sulphuric acid are required to acidulate phosphate rock in the manufacture of superphosphate. Generally speaking, it requires the same number of tons of sulphuric acid as of finely ground rock phosphate to prepare the common superphosphate material used in California agriculture. Sulphuric acid is manufactured from elemental sulphur or as a by-product from various industrial operations. The manufacture of superphosphate, however, does not require high grade sulphuric acid and frequently uses "spent acid" from the oil industry or other sources.

California is fortunate in having the potash-containing brines of large, salt-crusted lakes such as Searles Lake at Trona, California. Here the American Potash and Chemical Corporation recovers potassium chloride and potassium sulphate from the brine in sufficient quantities to meet the requirements of the West Coast, and in addition ships large quantities to the east. Many other valuable chemicals are also refined here such as borax, soda ash, and salt cake. The known deposits of potash-containing brine and of potash ores in the United States are limited and every effort should be made to discover additional supplies that undoubtedly will be needed for future agriculture needs.

The commercial distribution of agricultural minerals in California in order of importance is, gypsum, various types of lime including shells, marl, and by-product lime, and soil sulphur. Of these, gypsum accounts for approximately 80% of the total.

There is need for discovery of readily accessible, high-grade gypsum deposits near the great agricultural valleys. Gypsum is greatly desired to counteract excess soil alkalinity, which the farmer and grower believe retards movement of irrigation water into the soil and possibly locks up plant foods. Consumption of gypsum for these purposes has increased by six and seven fold since before the war, and promises to increase still further, provided agricultural production remains at a high level. Many of the deposits now being exploited are of low to medium grade, which causes additional transportation costs per unit of $CaSO_4 \cdot 2H_2O$. The majority of tonnage sales are guaranteed 70 percent although large quantities of other grades, such as 85 and 93 percent, are noted in the State Bureau of Chemistry Special Publication No. 227. Some gypsum as low as 20 percent is also reported for sale.

Also in need are quantities of high-grade dolomite, used by some growers to improve soil condition, and limited amounts of micro-nutrient materials, such as zinc, copper, iron, boron, and manganese. In the years to come these latter minerals, required in certain areas on special crops, will find more widespread use although the tonnage will never reach large proportions.

COLUSA COUNTY

General Geologic Features

The eastern half of Colusa County lies within the Sacramento Valley. It is covered with deposits of silt, sand, and gravels of the Quaternary period. The western half is within the foothills of the Northern Coast Ranges and includes beds of sandstone, conglomerate, and shales of Cretaceous and Jurassic ages. Ultrabasic intrusive rocks, chiefly serpentine, outcrop over an area of 15 square mile in the southwestern corner of the county in ihe vicinity of Wilbur Springs. The geology of Colusa County is shown on maps prepared by Jenkins (1938), Russell (1931), and Smith (1916), and published by this department.

Mineral Resources

A small amount of chromite was mined from lenses in serpentine in 1918. Gold has been mined from shallow deposits in sandstone and shale near the contact of Franciscan shales with intrusive serpentine near Wilbur Springs. Hot saline sulphur springs and cool carbonated springs occur in the western part of the county near the contact of Cretaceous sediments with Franciscan metamorphic rocks, and the ultra-basic rocks that intrude them. Seepages of oil occur in the Wilbur Springs district in the Knoxville shales near the contact with Franciscan chert and serpentine; in Knoxville sandstone beds along the axis of an anticline near Mountain House; and along the bottom of Sand Creek where it cuts through a small fold in the Chico beds west of Arbuckle. Cinnabar occurs in seams in serpentine and in the altered shales, sandstones, and conglomerates near serpentine contacts. It is associated with seams and ledges of opalized rocks. Sandstone is quarried from massive beds in the Cretaceous formations in the north central portion of the county. Sand and gravel deposits are mined on the banks and bars of the Sacramento River and tributary creeks. Salt has been produced by evaporating water from saline springs in Antelope Valley near Sites. Sulphur occurs in the quicksilver deposits at Sulphur Creek. The mines and mineral resources of Colusa County have been described by Logan (1929).

Significant Activities of 1947

The mineral production of Colusa County for 1947 consisted of gold, silver, sand and gravel. The latter was mined from four pits on the west bank of the Sacramento River between Colusa and Princeton. The material was used on roads and as an aggregate for concrete.

Mineral Production

Product	Quantity	Value
Gold	6 troy ozs.	$210
Sand and gravel	225,729 short tons	89,750
Silver	3 troy ozs.	3
Total value	-----	$89,963

NEW MINERAL DISPLAY

A new exhibit of ornamental minerals has recently been received by the State Division of Mines. It consists of 27 polished slices of colored and figured, transparent to translucent minerals mounted in the front face of a cabinet which is illuminated from behind. In this way, the coloring and configuration of the mineral slices is brought out, much more so than in displays of polished minerals not exhibited in transmitted light.

The donor, Mr. William B. Pitts, Honorary Curator of Gem Minerals in the California Academy of Sciences, has at various times presented the museum with other fine mineral specimens in addition to the illuminated ornamental exhibit. The California State Division of Mines gratefully acknowledges receipt of the display from Mr. Pitts.

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DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES
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DIVISION OF MINES
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MINERAL INFORMATION SERVICE

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GALLIUM

Occurrence

Gallium is found in small amounts in most zinc ores, in high alumina clays, in some hard manganese ores, and to a lesser degree in some pegmatites. In all of these, the amount of the gallium present ranges from traces to 0.1 percent, usually it is less than 0.05 percent. The richest known natural source of gallium is germanite, a sulfarsenite of copper, iron, and germanium ($5Cu_2S.12(Cu,Fe)S.As_2S_3.2GeS_2$) which frequently contains up to 0.7 percent of gallium. Gallium has been determined in all specimens of germanite tested; 35 of 91 iron ores tested contain traces of the element; 15 aluminum ores contain amounts up to 0.1 percent; many specimens of kaolin and bauxite contain gallium; 4 of 12 manganese ores contain amounts up to 0.02 percent; and 12 of 14 zinc ores contain amounts up to 0.05 percent. Commercially, gallium is recovered by the Eagle Picher Lead Co. (the largest U.S. producer) from flue dusts, zinc distillation residues, the electrolytic zinc plant purification residues, where the element concentrates to some extent in the form of an indium-gallium alloy or amalgam. To date no gallium is produced commercially by direct recovery from ores.

Properties

Gallium is a grayish, lustrous, crystalline solid of low malleability; atomic weight 69.72; melting point 29.75° C.; boiling point 1700° C.; specific gravity 5.904 for solid gallium, 6.095 for liquid gallium; alloys or amalgamates readily with many metals, including gold, silver, iron, copper, tin, cadmium, zinc, aluminum, and platinum. Most of its alloys or amalgams are liquid at room temperature. Gallium adheres to and spreads as a film on glass. The element is nonpoisonous to animals and has been used as an alloying metal in dental alloys. Gallium is slowly soluble in aqua regia, hydrochloric, nitric, and sulfuric acids, and in sodium and potassium hydroxide solutions. Electrochemically gallium is nobler than zinc but less noble than iridium.

Uses and Market

Gallium is a rare metal, and heretofore had no commercial use other than in quartz thermometers where the low melting point and high boiling point enabled temperature measurements within a higher range than mercury thermometers; low melting point alloys for limited industrial use; dental alloys; as an excitant in phosphors; and for giving a bright reflective film on glass. Recently, other and more extensive uses for gallium have developed as a result of its long liquid range and its properties when exposed to radiation. There is no established market price, but the nominal New York price for 99.9 percent gallium metal is $3.00 per gram. Information on buyers and marketing procedure may be secured from the U.S. Bureau of Standards, Washington D.C.

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CONTRA COSTA COUNTY

General Geologic Features

Contra Costa County embraces 734 square miles of land area on the southern shores of San Pablo Bay, Carquinez Straits, Suisun Bay, and the San Joaquin River. The most prominent topographic and structural feature is Mt. Diablo situated approximately in the geographical center of the county. It is one of the highest peaks in the central Coast Ranges rising to an elevation of 3,849 feet and has been selected as the intital point in the survey of the General Land Office controlling most of central and northern California.

Mt. Diablo is an oval-shaped mass of igneous, sedimentary, and metamorphic rocks of the Franciscan (Jurassic) formation covering about 15 square miles, protruding through the center of an anticlinal fold 50 miles long. The trend of the fold is northwestward and its flanks are composed of Cretaceous and Tertiary rocks which make parallel ridges of erosion about 2,000 feet high on the northeast and southwest sides of the mountain. Both Lower and Upper Cretaceous rocks are exposed and the Tertiary section consists of rocks from lower Eocene through Pliocene age. Quaternary alluvium covers the Tertiary and Cretaceous rocks in Ygnacio Valley northwest of Mt. Diablo and in the eastern part of the county along the delta of the San Joaquin River.

The geologic structure of the Mt. Diablo area consists of two elements: first, the anticlinal fold developed at the close of the Tertiary period, which traverses the county in a northwestward direction and extends beyond its borders in both directions; and second, the upthrust of the core of Franciscan rocks, as a fault plug, through the overlying Upper Jurassic and Cretaceous strata in the center of the anticline. The upthrust occurred after the close of the Tertiary period. The foothills on the southwest flank of the mountain are covered by continental sediments and interbedded volcanics of Pliocene age which structurally form a syncline, overturned to the southwest. These foothills descend on the west into the narrow trough of the northwest-trending San Ramon Valley. Drainage here is northwestward and the west side of the valley is the locus of the Sunol-Southampton (Calaveras) thrust fault. North of the town of Walnut Creek the Southampton fault cuts into the northwest end of the Mt. Diablo anticline.

A series of northwest-trending ridges marks the uplifted block west of the Southampt fault. The strata exposed range in age from Pliocene to Jurassic. Structurally they represent a series of anticlines and synclines locally faulted and overturned at numerous points. Eventually they merge westward with the tidal marsh of the bay.

Mineral Resources

The mineral resources of Contra Costa County are important owing to their proximity to the industrial centers surrounding San Francisco Bay. The important commercial minerals are: clay and shale for brick-making, limestone, mineral water, natural gas, pumice, quicksilver, sand, silica (moulding and glass sand), and miscellaneous stone (crushed rock). Local clay and shales at Richmond and Port Costa provide raw material for making common red brick. The production of coal, classed as sub-bituminous, began in 1861 from Eocene beds on the northwest flanks of Mt. Diablo. About 3,000,000 tons of coal, valued at $15,000,000, were produced by 1902 when mining ceased entirely. Conspicuous outcrops of recent limestone (travertine), used in cement making, are found along lime ridge about 5 miles southeast of Concord. The cement plant is located at Cowell. Mineral water from this county has been produced commercially for many years. The county also supplies moulding (silica) sand for the local steel industry centered around Pittsburg. The southeast end of the Rio Vista gas field extends into Contra Costa County and 7 wells operated by the Standard Oil Company produce gas from Eocene sands at a depth of about 4,500 feet. Pumice in the form of pumiceous tuff is found in the Pliocene volcanics extending northwestward from Mt. Diablo. Quicksilver, chiefly as metacinnabarite, is produced from ore bodies along the Franciscan serpentine-sandstone contact on the east side of Mt. Diablo. Deposits of fine dune sand of Quaternary age on the south shore of the San Joaquin River are mined in the vicinity of Antioch. Miscellaneous stone (crushed rock) is obtained from metamorphosed Franciscan sandstone and chert at numerous points throughout Contra Costa County. Small amounts of asphalt, copper, diatomite, gold, lead, and silver, have been produced.

Significant Activities in 1947

Brick-making and the manufacture of clay products, dinner-ware, and sanitary-ware, are important elements of the mineral industry in Contra Costa County. Local clay and shale are used by two brick companies in the manufacture of common red brick and hollow building blocks. Three additional plants purchase high-grade clays from Placer and Amador Counties which they use in making fire-brick, sanitary-ware, and clay products. A dinner-ware plant purchases Tesla clay which it blends with crude clay from out of state deposits.

Natural gas is produced from the southern end of the Rio Vista gas field which extends into this county. The seven producing wells are controlled by the Standard Oil Company and gas is delivered to the Pacific Gas and Electric Company pipe line. It is possible that additional wells may be drilled in this area.

Mineral water is produced commercially from springs located near Martinez at Alhambra Springs and Oil Springs. This water is bottled and distributed for Consumption in the San Francisco Bay area.

A small quantity of pumice is produced from a pumiceous tuff occurring in the foothills east of Pittsburgh. The crude material is crushed, screened, and used as an aggregate in the manufacture of building blocks.

Clay-free foundry sand is produced in small quantities from dipping beds of Eocene sandstone south of Antioch. The crude sand is washed, classified, and is used in preparing synthetic sands for iron foundries. A similar sand is also produced from Eocene beds in the workings of the old Nortonville coal mine near Clayton. The sand is mined by drifts and overhand stopes. It is transported to a crushing and washing plant near Pittsburgh where it is prepared for use in steel and iron foundries. The silica content of the end products from these two operations is 95 percent.

The south shore of the San Joaquin River in the vicinity of Antioch is bordered with dunes of fine sand. A number of operators, using dragline-buckets, load this sand directly to railroad cars for shipment to asphalt plants.

Large quantities of crushed rock are produced from indurated sandstone at Blake Bros. Richmond quarry. Basalt is the source of crushed rock at the Upton quarry of Henry J. Kaiser Company.

Mineral Production

Product	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)----------	-----	(3)
Sand and gravel----------------------	378,734 short tons	$248,403
Stone--------------------------------	472,020 short tons	509,546
Unapportioned (raw clay, natural gas, and pumice)----------------------	-----	630,733
Total value----------------------	-----	$1,388,682

(3) U.S. Bureau of the Census not at liberty to publish figure. Value not included in county total.

INCREASED USEFULNESS OF TOPOGRAPHIC MAPPING

Recent developments in methods and policy by the U.S. Geological Survey have greatly increased the usefulness of the topographic quadrangle mapping by that agency.

It is now possible, as soon as the mapping of any quadrangle has reached the stage where color separation drawings have been prepared, for any map user in the Pacific Coast States to obtain from the Pacific Division Office of the U.S. Geological Survey, Federal Building, Sacramento, California, a one color ozalid print from a composite film positive on a scale of 1:24,000 (1" = 2000').

These large scale prints will be available for all new quadrangles mapped from now on, even to the summit of the Sierras and for desert areas. They will ve very close to accurate scale and may be readily joined with adjacent quadrangles when so desired. This will make possible a uniform working scale throughout the west.

For the valley and foothill areas which are to be published in color as 7½' quadrangles, the color print (obtainable a few months before the published map will be available) will be printed direct, in a vacuum frame, from the composite film positive made up from the color separation negatives in such a way as to subdue the contour lines and accentuate the streams so that canal lines, for example, may be more readily distinguished from contours on the one color prints. The price of such direct prints will be 40 cents each.

For areas which are to be published only as 15' quadrangles, a film positive for each of the four 7½' quadrangles will be made by enlargement from the 15' composite. For such quadrangles, the charge will be 60 cents per print. This will cover the cost of the film positive enlargement when the demand from various map users reaches a total of 50 prints.

Similar one color 7½' quadrangle prints may also be obtained from any previously published 15' quadrangle by enlargement, but in such cases the cost of the enlargement must be paid by the person or agency ordering the prints, because other demands for such older mapped quadrangles are not expected. By appropriate use of color filter, the streams are preserved in the enlargements made from previously published maps.

This service will now make available, with very nearly the same percentage of accuracy as the published quadrangles, maps on a scale large enough to be useful for many engineering and geological studies without the heretofore necessity of photostatic enlargement of the 1 mile per inch published maps, which method, it was proven by checks on enlargements actually used in engineering work, increased the allowable error of the published map by 5 to 10 times due to uneven shrinkage of the wet process papers used.

The officials and employees of the U.S. Geological Survey who cooperated so wholeheartedly in the development of this new service should be congratulated, and they should be given full support of all engineering, geological, mining, lumbering, and agricultural organizations, and industries in securing adequate funds for the continuance and speeding up of their good service which is a very necessary foundation for many industrial and agricultural projects, as well as for possible defense.

A list of maps published by the U.S. Geological Survey for general distribution during the month of May has recently been issued, and may be obtained from the State Department of Public Works, Division of Water Resources, Sacramento, California.

URANIUM

Uranite (pitchblende) is considered an uranate of uranyl salts and lead with varying percentages of the rare earths, thorium, cerium, yttrium, lanthanum, and erbium, and the gases nitrogen, argon, and helium. It may also contain radium and be strongly radioactive. Radium was first discovered in this mineral and it has been shown that it and the helium present are products of the breaking down of the uranium. Crystals are rare. It is usually found massive and botryoidal; also in grains. Luster is submetallic to greasy or pitch-like on fresh fracture surface, otherwise dull. Color is brown to black. Streak is dark green, brown, or black. The mineral may occur as a primary constituent in granitic rocks or as a secondary mineral with ores of silver, lead, and copper.

Carnotite is essentially a hydrous potassium-uranium vanadate containing small amounts of radium. Crystals are small, tabular, and with a rhombic outline. Usually observed in scaly aggregates, incrustations, or as a crystalline powder. The color is canary to lemon yellow. Luster is resinous to dull. It is transparent to translucent. Fracture, earthy. It occurs as a yellow powdery incrustation in loosely cohering masses or as an impregnation in sand or sandstone. Common associates are malachite, azurite, biotite, and magnetite; sometimes associated with the hydrous calcium-uranium vanadate, known as tyuyamunite.

Since all uranium ores are "spotty" and irregularly distributed in scattered and usually relatively small deposits, prospecting constitutes in all localities an important factor even after commercial development has begun. Many of the uranium minerals are brightly colored, either yellow or green, and even the black varieties have a characteristic appearance, so that ore bodies are readily recognized if they crop out. More often they do not crop out, and the search for ore involves a careful study of the geological conditions. Local differentiations in the appearance or associations of the minerals in the vein filling may lead to the discovery of ore shoots.

Portable Geiger counters that are useful in detecting radioactive minerals are available from Braun-Knecht-Heimann Company, San Francisco and Los Angeles, California; Engineers Syndicate, Ltd., 5176 Hollywood Blvd., Hollywood 27, California; Fisher Research Laboratory, 1961 University Avenue, Palo Alto, California; Technical Associates, 3730 San Fernando Blvd., Glendale 4, California; National Technical Laboratories, South Pasadena, California; W.D. Brill Company, 198 10th Street, Oakland 7, California; University Apparatus Company, 2229 McGee Avenue, Berkeley 8, California, and Ultra-Violet Products, Inc., 5205 Santa Monica Blvd., Los Angeles 27, California.

In prospecting and in delineating ore bodies, all the usual methods may be employed; but even core drilling is uncertain, unless holes are closely spaced, for there is usually little continuity for the deposits. A test for radioactivity is not a conclusive test for radium and uranium, for thorium also has a disintegration product, mesothorium, which closely resembles radium in its behavior. The appearance of the minerals will generally determine which of the elements is present, but in case of doubt the determination requires some elaborate tests which should be made by an experienced chemist. The patchy nature of uranium ore deposits precludes the adoption of large-scale methods of mining. Gophering seems to be the most economical means of mining, and in all districts hand-picking methods are used in preparing ore for shipment.

A new use has been found for uranium in the "atomic bomb". These are really nuclear bombs because the forces involved deal only with the nucleus of the atom. In the nuclear reaction of fission the nucleus breaks into approximately equal parts. At least three nuclei, those of thorium, protactinium, and uranium exhibit fission. Tremendous energy is released in nuclear fission.

Domestic Uranium Production Program

The United States Atomic Energy Commission has announced a three-point program to stimulate discovery and increase production of domestic uranium. The Federal Government has guaranteed minimum prices for a ten-year period covering refined uranium oxide, high-grade uranium ore, and mechinical uranium concentrates. It has offered a bonus of $10,000 for each discovery leading to production of ore to the amount of 20 short tons assaying 20 or more percent of U_3O_8, and has guaranteed, for a three-year term, minimum prices for low-grade carnotite and roscoelite-type uranium-vanadium ores from the Colorado plateau area.

Although uranium in deposits on U.S. public lands is reserved for the use of the Federal Government by authority of the Atomic Energy Act of August 1, 1946, the Commission encourages prospecting for new deposits of uranium ores on the public domain and on privately-owned lands. To mine uranium on privately-owned lands, a license is required from the U.S. Atomic Energy Commission. The Department of the Interior will validate locations of uranium deposits on public lands if they occur in association with other valuable minerals. In the unlikely event of discovery of uranium unassociated with other valuable minerals, the Commission will take steps to protect the prospector's equity.

Minimum price for domestic refined uranium compounds, high-grade uranium-bearing ores, and mechanical concentrates has been set at $3.50 per pound of recoverable uranium oxide (U_3O_8) less the cost per pound to refine to purity required by the Atomic Energy Commission after assay of a representative sample. The established minimum price is for small lots. Higher prices may be established by negotiation with the AEC for large-quantity operations and for ores containing recoverable amounts of other valuable minerals such as gold, silver, radium, thorium, vanadium, etc. Higher prices are dependent upon conditions of transportation, milling, and other applicable items.

Circulars describing the new policies in detail are available without cost from the U.S. Atomic Energy Commission, P.O. Box 30, Ansonia Station, New York 23, N.Y., Attention: Division of Raw Materials.

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MINING AND INDUSTRIAL NEWS NOTES

New Interest in Asbestos

The prolonged strike tying up the Canadian asbestos mines has shut off the supply of asbestos from California manufacturers and has stimulated the search for asbestos deposits in northern California. Properties that have had some production in recent years are being examined for possible sources of supply.

One of the newest developments is the location of a group of asbestos claims in the Highland Lake area in Shasta and Trinity Counties by N.J. Lockhart and associates of La Moine. Chrysotile asbestos occurs in serpentine in this area. The fibers are mostly short but suitable for tile and paper stock. A mill is being assembled to process the material at Eagle Roost Point about a mile south of Gibson on Highway 99. The crude material will be disintegrated in a hammer mill and the asbestos fibers separated by air jets. Eight men are employed assembling the mill and improving the road to the mine.

New Oil Discovery in Ventura County

A new oil-producing horizon was discovered in the Lion Mountain Area of the Ojai district, Ventura County, in late May 1949, by the Humble Oil Company. Lion Mountain is located about 1½ miles southeast of the town of Ojai in an area from which some oil was obtained in the Sespe (chiefly Oligocene) formation in past years. The new producing horizon is in Eocene sands lying at an interval between 3,990 to 4,035 feet below the surface. The oil is 17 to 23 gravity and the well flowed at an initial rate of 70 barrels per day.

REFERENCE LIST OF RECENT PUBLICATIONS

The references listed below are available for study in the Library of the Division of Mines but are not on sale by the Division.

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Mine production of gold, silver, copper, lead, and zinc in California, 1948, by counties in terms of recovered metals

County	Mines producing 1/		Gold				Silver			
			Fine ounces		Total		Fine ounces		Total	
	Lode	Placer	Lode	Placer	Fine ounces	Value	Lode	Placer	Fine ounces	Value
Alpine	2	—	8	—	8	280	2	—	2	2
Amador	8	6	5,399	1,215	6,614	231,490	2,085	167	2,252	2,038
Butte	1	15	1	26,136	26,137	914,795	—	1,990	1,990	1,801
Calaveras	18	5	1,017	179	1,196	41,860	617	23	640	579
Colusa	1	—	2	—	2	70	1	—	1	1
El Dorado & Humboldt 2/	10	6	1,006	1,660	2,666	93,310	1,203	201	1,404	1,271
Imperial	4	—	171	—	171	5,985	93	—	93	84
Inyo & Fresno 2/	36	3	1,771	284	2,055	71,925	573,282	47	573,329	518,892
Kern	32	4	5,661	515	6,176	216,160	13,419	90	13,509	12,226
Lassen	2	—	121	—	121	4,235	102	—	102	92
Los Angeles	1	2	9	206	215	7,525	3	33	36	33
Madera & Merced 2/	1	5	—	19,279	19,279	674,765	42	1,852	1,894	1,714
Mariposa	16	5	5,470	2,055	7,525	263,375	1,741	425	2,166	1,960
Modoc	1	—	141	—	141	4,935	73	—	73	66
Mono	6	—	63	—	63	2,205	788	—	788	713
Monterey	2	—	24	—	24	840	6	—	6	5
Napa	1	—	2	—	2	70	29	—	29	26
Nevada	13	19	100,491	1,360	101,811	3,563,385	29,583	161	29,744	26,920
Placer	7	17	436	894	1,330	46,550	1,362	141	1,503	1,360
Plumas	3	13	77	622	699	24,465	12	54	66	60
Riverside	3	—	4	—	4	140	101	—	101	91
Sacramento	—	12	—	118,152	118,152	4,135,320	—	6,491	6,491	5,875
San Bernardino & San Joaquin 2/	28	4	1,356	2,091	3,447	120,645	57,514	226	57,740	52,258
San Diego	3	—	8	—	8	280	3	—	3	3
Shasta & Stanislaus 2/	9	8	796	24,142	24,938	872,830	17,601	2,350	19,951	18,057
Sierra	6	14	9,687	743	10,430	365,050	2,316	89	2,405	2,177
Siskiyou	11	30	221	21,005	21,226	742,910	53	2,704	2,757	2,495
Trinity	3	19	722	7,208	7,930	277,550	149	862	1,011	915
Tuolumne	12	2	1,285	29	1,314	45,990	1,108	5	1,113	1,007
Yuba	1	6	8	57,781	57,789	2,022,615	1	3,571	3,572	3,233
Total: 1948	241	195	135,917	285,556	421,473	14,751,555	703,289	21,482	724,771	655,954
1947	210	210	118,877	312,538	431,415	15,099,525	1,573,428	24,010	1,597,442	1,445,685

Mine production by counties, continued

County	Copper		Lead		Zinc		Total Value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine	6,000	$1,302	———	———	———	———	$1,584
Amador	———	———	———	———	———	———	233,528
Butte	———	———	———	———	———	———	916,596
Calaveras	———	———	2,000	$358	———	———	42,797
Colusa	———	———	———	———	———	———	71
El Dorado & Humboldt 2/	72,000	15,624	———	———	———	———	110,205
Imperial	———	———	———	———	———	———	6,069
Inyo & Fresno 2/	598,000	129,766	17,240,000	3,085,960	9,320,000	1,239,560	5,046,103
Kern	———	———	———	———	———	———	228,386
Lassen	———	———	———	———	———	———	4,327
Los Angeles	———	———	———	———	———	———	7,558
Madera & Merced	10,000	2,170	———	———	———	———	678,649
Mariposa	———	———	———	———	———	———	265,335
Modoc	———	———	———	———	———	———	5,001
Mono	———	———	4,000	716	———	———	3,634
Monterey	———	———	———	———	———	———	845
Napa	———	———	———	———	———	———	96
Nevada	———	———	———	———	———	———	3,590,305
Placer	———	———	———	———	———	———	47,910
Plumas	———	———	———	———	———	———	24,525
Riverside	———	———	2,000	358	———	———	589
Sacramento	———	———	———	———	———	———	4,141,195
San Bernardino & San Joaquin 2/	118,000	25,606	838,000	150,002	438,000	58,254	406,765
San Diego	———	———	———	———	———	———	283
Shasta & Stanislaus 2/	156,000	33,852	106,000	18,974	892,000	118,636	1,062,349
Sierra	2,000	434	28,000	5,012	———	———	372,673
Siskiyou	———	———	———	———	———	———	745,405
Trinity	———	———	———	———	———	———	278,465
Tuolumne	———	———	———	———	———	———	46,997
Yuba	———	———	———	———	———	———	2,025,848
Total: 1948	962,000	208,754	18,220,000	3,261,380	10,650,000	1,416,450	20,294,093
1947	4,814,000	1,010,940	20,160,000	2,903,040	10,830,000	1,310,430	21,769,620

1/ Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
2/ Combined to avoid disclosure of individual output.

NEW PUBLICATIONS OF THE DIVISION OF MINES

Reprint, Bulletin 123, American Mining Law

American Mining Law, by the late A.H. Ricketts of the San Francisco Bar, one of the best-known and experienced attorneys in this highly specialized branch of the law, is an interesting as well as instructive book. It contains chapters on mining terms and phrases; oil mining terms and phrases; natural objects and permanent monuments; minerals and mineral lands; the public domain; insular possessions; vein, lode, and ledge; placers; surveys; land department; federal and state courts; local rules, regulations and customs; supplemental state legislation; federal statute of limitations; state statutes of limitations; adverse suits; suits affecting mining patents; possessory actions; abandonment; adverse claims; annual expenditure; boundaries; commingling of ores; conditional sales; corporations; costs; deeds; discovery; drainage; easements; eminent domain; fixtures; flooding of mines; forfeiture; highgrading; intralimital and extralateral rights; location notices; locations; locators; lode claims; lodes within placer claims; mill sites; mineral liens; mining leases; mining licenses; mining partnerships; mining patents; mortgages; oil and gas lands; oil shale lands; opinions; patent proceedings; possession; rescission; separate property; statute of frauds; surface rights; tenancy in common; and waiver.

There are also articles on federal statutes, rules of practice (U.S. Land Office), Californian statutes, and state statutes (penal legislation affecting ores).

In two volumes, price $3.00, cloth-bound.

Bulletin 142, The Counties of California - Mineral Resources and Mineral Production

This bulletin represents the Division's annual publication on mineral statistics including, as a special feature, a summary of the mineral resources of each and every county in the state. For the first time all the essential features of mineral information concerning the separate counties has been assembled under one cover; general geologic features, mineral resources, significant mining activities during 1947, and mineral production. It is the first statistical bulletin which contains the results of the cooperative agreement entered into with the federal Bureau of Mines whereby the latter organization gathers and processes the production figures directly from the producers.

The book is divided into three parts. Part 1 consists of a brief summary of the mineral commodities in the state, with a table showing the quantity and value of each of the mineral substances produced. In addition, a statement and table are given to show the total value of minerals produced in each county. Several graphs are included to indicate relationship between California and other leading mineral-producing states and the relationship between the principal mineral-producing counties of California.

Part 2 forms the bulk of the bulletin and is devoted to treating each county briefly in the following manner; general geologic features, mineral resources, significant activities during 1947, and table of mineral production.

Part 3 does not contain any descriptions but is intended to serve as a directory of mineral producers and to give useful lists of smelters, mineral dealers, custom mills, commercial grinding plants, buyers of quicksilver, assayers, and testing laboratories.

It is intended that the annual statistical report for 1948 will describe in more detail the occurrences, uses, and the production of mineral commodities as such rather than by counties. In the following year, the bulletin may be devoted to marketing minerals. In this manner it is hoped that these annual mineral production bulletins will serve a lasting value as texts to all phases of the mineral resources and industry of the state.

Orders for this publication, to be available by mid-August, are now being taken. Price, paper-bound, $1.25.

Reprint, Bulletin 118

The second printing of Bulletin 118, Geologic Formations and Economic Development of the Oil and Gas Fields of California, is now ready for distribution. The first edition of 4,000 copies, printed in 1943, was exhausted in October 1948.

Until the publication of Bulletin 118, there had been a genuine need for a treatise on the oil and gas resources of California. Petroleum in California is outstanding among our diversified mineral resources of economic value and utilization both in normal peace-time activities and during time of war. The value of the production of petroleum, natural gas, and allied products has amounted to about 80% of total California mineral production in recent years. The theme of Bulletin 118 is geology - the guiding science in exploration for oil and gas, and it has been our aim to issue a useful and authentic source book. In all, 126 authors have contributed to the entire bulletin.

Bulletin 118 has been arranged in four parts. Part One, Development of the Industry, pp. 1-80, contains Chapter I, Development and Production; Chapter II, Exploration; and Chapter III, Early History.

Part Two, Geology of California and the Occurrence of Oil and Gas, pp. 81-276, contains Chapter IV, Introduction to the Geology; Chapter V, Geologic History and Structure; Chapter VI, Paleontology and Stratigraphy; and Chapter VII, Occurrence of Oil.

Part Three, Descriptions of Individual Oil and Gas Fields, pp. 277-664, contains Chapter VIII, Los Angeles Basin and Southernmost California; Chapter IX, Ventura Basin and Transverse Ranges; Chapter X, Santa Maria Basin and Southern Coast Ranges; Chapter XI, San Joaquin Valley and Bordering Foothills; Chapter XII, Northern San Joaquin Valley, Sacramento Valley, and Northern Coast Ranges; and Chapter XIII, Tabulated Data on Wells Drilled Outside of the Principal Oil and Gas Fields; there are also Citations to Selected References throughout Part Three.

Part Four, Glossaries, Bibliography, and Index, pp. 665-773, contains Chapter XIV, Glossary of the Geologic Units of California; Chapter XV, List of Publications Cited Throughout Bulletin 118; and Chapter XVI, Index to Bulletin 118.

Bulletin 118 contains 6 plates, 283 figures, 81 index maps to individual oil and gas fields (on the same scale as the Geologic Map of California - 1:500,000), and an Outline Map of California Showing Oil and Gas Fields and Drilled Areas - Economic Mineral Map of California No. 2, Oil and Gas, scale 1:1,000,000 (folded in pocket).

Cloth-bound copies of Bulletin 118, may be obtained at the San Francisco office or any of the branch offices at a cost of $6.00. California residents should add 3 percent sales tax.

July Issue of California Journal of Mines and Geology

The California Journal of Mines and Geology, vol. 45, no. 3, for July 1949, is now ready for distribution.

This issue contains Part 2 of Wilbur Somerton's paper on "Water-Flooding as a Method of Increasing California Oil Production," entitled "A Survey of California Conditions Relative to the Application of Water-Flooding." "Mines and Mineral Resources of Butte County," by J.C. O'Brien, lists the mineral resources separately and describes the mining activities connected with them.

Other outstanding articles in the Journal are Stuart H. Ingram's paper on "Roofing Granules in the Southwest," which tells about the various types of roofing, the growth of the industry, and the specifications for raw material. "The Western Pulp and Paper Industry as a Consumer of Chemicals," by R. G. Mispley, gives one an idea of the chemicals used in pulp production, sizing materials, fillers and coating materials, dyestuffs, and the opportunities for development of western resources. "Mining Law in Recent Years," by William E. Colby, is the second of a contemplated series of articles intended to bring the subject up to date. F.T. Johnson and Spangler Ricker have written a paper on the "Ione-Carbondale Clays, Amador County, California," which gives a description of the deposits, the exploration work done by

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the Bureau of Mines, and their method of sampling. This issue also contains the "Address of Governor Earl Warren to the American Institute of Mining and Metallurgical Engineers, Inc."

Single issues of the Journal sell for 75¢ each; yearly subscriptions are $2.50.

Olaf P. Jenkins, Chief
State Division of Mines
Ferry Building
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MINERAL INFORMATION SERVICE

Vol. 2 September 1, 1949 No. 9

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MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

MINERAL NEEDS OF THE GLASS CONTAINER INDUSTRY IN CALIFORNIA

by Richard L. Cheney, West Coast Mgr.,
Glass Container Manufacturers Institute, Inc., San Francisco

Glass is one of the few common remaining mysteries of the chemical realm. It is described by the physical chemist as an "undercooled liquid", for it has no freezing point, but attains its rigid condition through a gradual hardening as it cools. Chemically, it is apparently a mutual solution of several oxides, one being silica (SiO_2), the others being at least partly combined into simple or complex silicates. However, we cannot tell exactly what the compounds in any given sample of glass may be. Sand or silica alone can be fused into glass (quartz) at extremely high temperatures. Most commercial glasses, however, include as well, generous portions of both soda and lime, which serve to reduce the melting temperature and give greater "workability" to the product. Other mineral raw materials also are often added in lesser quantities.

Glass, as a container material, is unique in that it is made directly from basic raw materials into the final product, without passing through intermediate forms and a series of "converting" operations. The all-mineral raw materials in dry granular form are well mixed and fed into a continuous tank or furnace where they float on the surface until melted by the heat of overhead luminous gas flames. Farther on in the same tank the glass is refined, and then fed in gobs to the waiting molds of the automatic glass-blowing machines. The basic raw materials of glass are abundant and low cost, and the transparency and relative chemical inactivity of glass make it an ideal container material for many purposes.

Unfortunately no accurate data are available as to the annual mineral requirements of the glass industry in California. However, we know that probably 95 percent of the California glass tonnage goes into containers, and it is generally supposed that the twelve glass container plants operating in California produce about 10 percent of the national tonnage, a quantity which is known. From this last fact, it is estimated that the principal annual mineral needs of the glass container industry in California are as shown in table I.

TABLE I
Estimated Annual Mineral Needs - California Glass Container Industry

	At 100% of Rated Capacity	At Current Rate of Production
	Tons	Tons
Glass Sand	550,000	410,000
Soda Ash	154,000	113,000
Limestone	110,000	82,000
Salt Cake	8,000	6,000

Also smaller quantities of:

Nitre
Arsenic
Selenium Salts
Cobalt Oxide

and Colorizers

The specifications covering raw materials used in glass container manufacture are necessarily rigid. They are indicated below, together with information as to the areas from which the basic raw materials are presently drawn by the California section of the industry.

Glass Sand. Sand must be of the highest possible silicon dioxide (SiO_2) content, except that some feldspathic material can be tolerated, and is even desirable up to 4 percent, providing the contents and ratios of alumina (Al_2O_3), sodium oxide (Na_2O), potassium oxide (K_2O) and calcium oxide (CaO) do not vary. Iron, which occurs in glass sand in the form of ferric oxide (Fe_2O_3), should not exceed 0.04 percent by weight, and cannot be tolerated above 0.06 percent. Sand should not contain particles which cannot pass a 20-mesh screen. There are no known deposits of sand in California which approach the above specifications and so all California glass sand undergoes a more or less extensive processing, including "washing", to bring it up to required standards. Proximity to rail or barge transportation is an important factor in the successful development of sand deposits.

Present sources of supply are:

(a) Monterey Peninsula, where the sand before processing contains 10 to 12 percent alumina, and excessive amounts of iron.

(b) Riverside County, where the deposits consist of about 40 percent clay, which must be washed out first, following which the iron, which is on the outside of the grains, must be removed by scrubbing and a magnetic separator.

(c) Mead Lake, Nevada, which, after washing only, yields a sand with 98 to 99 percent SiO_2, and an iron content within allowable limits. In use it is either mixed with California sand to supply the desired alumina, or feldspar is added to the batch.

At one time, deposits near Brentwood in Contra Costa County were used, but they have been abandoned as the sand occurred in small pockets, making the operation too costly, and it is reported that there was an undesirable variation in the alumina and iron content.

Soda Ash. This must be not less than 99 percent sodium carbonate (Na_2CO_3) and is specified as "dense-58 percent Na_2O." So-called "light" soda ash is generally not satisfactory for glass making in continuous process tanks. The soda ash used by the California glass industry comes from plants located at the source of raw materials at Searles Lake, and Owens Lake, California.

Limestone. This should be essentially calcium carbonate ($CaCO_3$) with the combined total of CaO and MgO not less than 55 percent by weight. Dolomitic limestone, containing magnesium carbonate ($MgCO_3$) is satisfactory so long as the MgO component does not exceed 5 percent of the total weight, and so long as the percentage of MgO remains uniform. Ferric oxide (Fe_2O_3) should not exceed 0.035 percent. Grain size should all be finer than 20-mesh, and essentially coarser then 100-mesh. It is customary for the glass company to specify grain size to match the sand being used, in order to reduce batch segregation to a minimum. Limestone of course occurs widely throughout California, but the distances from the San Francisco Bay and greater Los Angeles glass producing areas, or from railroad lines, eliminates consideration of many of the deposits. Purity is also important, and from the specifications it will be seen that the higher calcium limestones of the northern part of the state are better for glass making. At present the industry draws its supplies from Tuolumne, El Dorado, and Riverside Counties.

Salt Cake. This must be essentially sodium sulphate (Na_2SO_4). It is used in relatively small quantities and comes from the same plants furnishing other soda products.

Other Minerals. The nitre, or sodium nitrate ($NaNO_3$) used is generally the single-refined Chilean product, of about 99 percent purity. Arsenic, used as a decolorizer, is in the form of arsenic trioxide (As_2O_3), a by-product of the copper smelting industry and is not available from California sources. The same is true of selenium, which is also used as a decolorizer, in the form of barium selenite ($BaSeO_3$) or sodium selenite (Na_2SeO_3). Colorizers, to make colored glass, consist of ground coke or anthracite coal dust, for amber glass, and chrome ore for green. Both are obtained from the east, as the quantity consumed does not warrant developing California sources.

Whether the mineral needs of the glass container industry in California will start expanding once more, following its post-war decline, will depend upon the success of the industry in marketing such potentially large volume new items as the single trip one-way beer bottle, and the baby-food jar. The industry is very hopeful that its efforts in this direction will result in much nearer to capacity operation in 1950.

IODINE

Iodine, although a widely distributed element, is found in small amounts and is not known to exist in the native state (uncombined with other elements). Iodine-bearing minerals occur with certain silver and lead ores. Iodine has been detected in plants and animals, particularly in marine plants and animals, and certain kinds of seaweed are a commercial source of iodine in Japan and Scotland. The caliche of the Chilean nitrate fields, which contains about 0.2 percent iodine as iodate, is the source of more than half the world's supply. The salt water produced with oil from certain oil wells, particularly those in southern California, contains iodine in recoverable amounts.

Iodine at ordinary temperatures is a dark, bluish-black crystalline solid, having a specific gravity of 4.9, which vaporizes easily to a violet vapor. It is slightly soluble in water but dissolves readily in organic solvents. Dissolved in carbon disulfide, chloroform, or benzene, iodine is violet; dissolved in alcohol, ether, or acetone, iodine is brown. Its chemical properties are similar to those of the other halogens, fluorine, chlorine, and bromine.

Iodine minerals are comparatively rare. Cerargyrite ($AgCl$) sometimes contains iodine as a replacement of chlorine. Iodobromite ($2AgCl.2AgBr.AgI$), a mineral of the cerargyrite group, crystallizes in the isometric system and has a specific gravity of 5.7. Its color is sulfur yellow or greenish. Iodyrite (AgI) is hexagonal-hemimorphic. It usually occurs in thin yellow or green plates and has a specific gravity of 5.5 to 5.7. Artificial compounds are many; potassium iodide is perhaps the most common.

Since about 1928, iodine has been produced in California from the brines of certain oil wells in the Los Angeles area. There are now four plants, one each at Dominguez Hill, Seal Beach, the Venice field, and the Inglewood field, operated by the Dow Chemical Company and the Deepwater Chemical Company for the recovery of iodine. The brine varies from well to well, and that from the deeper zones contains less iodine than that from the shallower. It is slightly alkaline and contains less salts than sea water. The iodine content varies from 10 to more than 100 parts per million. A typical brine analysis is as follows:

	Parts per million
SiO_2	34
Fe_2O_3 and Al_2O_3	55
Ca	520
Mg	234
Total alkali as Na	10,759
SO_4	40
Cl	15,100
HCO_3	1,584
I	50
Br	90
Total solids	28,301

Barium is present also

The Dow Chemical Company's method of recovery resembles the blowing-out process for the recovery of bromine. Oil field waste water is received in tanks where the suspended solids settle out and much of the oil is skimmed off. The water is then further cleaned in a Dorr clarifier and run through a series of settling tanks and finally a sand filter. Ferric chloride and acid are added to facilitate the settling of impurities.

Chlorine gas added to the acidified cleaned water liberates the iodine. Careful control of Cl_2 is necessary to prevent the liberation of bromine along with the iodine. Iodine is removed from the water in a blowing-out tower which consists of a vertical cylinder packed with rings made of ceramic material. The water which now contains elemental iodine enters the top of the tower and meets a rising current of air. Iodine is carried by the air out of the tower, and the water, freed of its iodine content, goes to waste. The iodine is now absorbed in a similar but smaller tower, and the cleaned air is sent back to the blowing-out tower. In the absorbing tower a solution of SO_2 in water absorbs the iodine according to the reaction:

$$I_2SO_2+2H_2O = H_2SO_4+2HI$$

This absorbing solution is maintained at a constant iodine concentration of 1 pound of iodine per gallon by dilution with fresh water. Periodically some is withdrawn and sent to the finishing department.

In the finishing department iodine is again liberated with chlorine. The concentration is now high enough so that the iodine may be recovered by filtration. This product is purified and dried by treatment with hot concentrated sulfuric acid. Liquid iodine is cast into cakes which are broken up and packed in kegs for sale.

The Deepwater Chemical Company's plant is at Dominguez Hill. C.W. Girvin, W.S. Witmer, and Levering Lawrason of this organization have perfected the silver method of recovering idoine. Salt water from the oil wells is first cleaned by a patented process which floats off the dirt as a froth. The clear water is then run into one of three large wooden batch-precipitation tanks where a calculated amount of silver nitrate is added in a one percent solution. A colloidal precipitate of silver iodide forms which, with the aid of a coagulating agent, ferric chloride, settles within an hour. Agitation is provided by a small impeller. When the reaction is complete the solution is decanted through a filter to recover any suspended silver iodide, ferric hydroxide, and ferric soaps. It is then hosed out and put in small tanks where it is heated with steam and treated with acid to remove iron. The silver iodide is then collected on vacuum filters and roasted to remove traces of oil. The roasted silver iodide is placed in a tumbling machine with water and metallic iron, and after four to five hours the silver is liberated as a white powder. The silver powder is filtered out, roasted in air to remove traces of oil and carbon picked up from the steel, and redissolved in nitric acid.

Iodine is taken from the tumbling machine in the form of a concentrated solution of ferrous iodide. Chlorine is used to displace the iodine from the ferrous iodide. Iodine so displaced collects as a finely divided solid which is filtered and washed. If pure iodine is desired, the impure material is sublimed.

To make potassium iodide, the crude iodine is treated with potassium hydroxide which yields a solution containing potassium iodide and potassium iodate. When this solution is evaporated to dryness and fused, the iodate changes to iodide. The crude iodide when dissolved and reprecipitated yields a very pure product.

The Division of Mines wishes to acknowledge the help and cooperation of the following officers of the Dow Chemical Company: R.L. Curtis, General Manager at San Francisco, Fred Lusk and V.E. Dyckman, Manager and Assistant Manager respectively at the Seal Beach plant. It is equally indebted to C.W. Girvin of the Deepwater Chemical Company.

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DEL NORTE COUNTY

General Geologic Features

Del Norte County lies within the rugged and complex Klamath Mountain province. Intrusive rocks, chiefly serpentine and peridotite cover most of its area except for a belt of Franciscan sandstone and shales five to ten miles wide along the coast, and the outcrops of diorite and granodiorite that make up the mountains along the border of Siskiyou County. Small areas of diorite and granodiorite also occur in the serpentine belts, and there are remnants of metamorphic, sedimentary, and volcanic rocks which have been intruded by both the granitic rocks and the peridotite. The geology of Del Norte County is shown on maps prepared by Jenkins (1938), Maxson (1933), and Smith (1916), and published by this department.

Mineral Resources

Chromite occurs in lenses in serpentine. Copper minerals, chiefly chalcopyrite, are also found in veins and lenses in serpentine at or near the contact with granitic rocks. Pyrite and pyrrhotite are accessory minerals. Gold and platinum are found in the stream gravels and beach sands associated with magnetite and chromite. Gold also occurs in narrow quartz veins and stringers in greenstone and slate near the contact with diorite and granodiorite. Native quicksilver and cinnabar occur in vugs and fissures in serpentine and the rocks in contact with it. Sand and gravel are mined from the banks and bars of the Smith River, and heavy boulders for building and harbor jetties were quarried from the greenstone outcrops on Preston Island. The mines and mineral resources of Del Norte County have been described by Laizure (1925) and Maxson (1933).

Significant Activities of 1947

The Tyson Chrome mine at French Hill was converted into an open pit operation in 1947. Water was brought from French Hill through 2½ miles of ditches and delivered to a No. 3 giant under a 250-foot head. The physical characteristics of this deposit are favorable for a hydraulic operation. The serpentine is soft and broken and a good slope provides plenty of dump room for tailing. Chromite occurs in irregular lenses and was difficult and expensive to mine by underground methods.

Shults Brothers installed a 25-ton capacity Lacy rotary furnace at the Webb quicksilver mine during the year and a new adit was driven to develop the deposit at a lower elevation. A bunk house and dining hall were built to accomodate the crew.

Rock was quarried at Preston Island and used to build the jetties at Crescent City Harbor. Sand and gravel were mined from pits on the banks of Smith River and used for concrete aggregate and on roads.

Mineral Production

Product	Quantity	Value
Chromite	640 short tons	(2)
Sand and gravel	55,017 short tons	(2)
Unapportioned (chromite, sand and gravel and stone)	----	$322,156
Total value	----	$322,156

(2) Value included with "Unapportioned".

Descriptions similar to the above (more extended for counties that produce more mineral substances) of every county in the state are published in State Division of Mines Bulletin 142, The Counties of California, Mineral Resources and Mineral Production During 1947. Price $1.25 per copy, paper cover.

NEW UNITED STATES GEOLOGICAL SURVEY PUBLICATIONS

Topographic Mapping in the U.S.

Two index maps "A" and "B", Status of Topographic Mapping in the United States its Territories and Possessions, scale 1:5,000,000 were released in March 1949. One shows areas covered by maps at standard scales of one inch to the mile and larger. The other shows areas covered by maps at scales of one inch to the mile and smaller.

These should enable one to determine readily the quality and extent of the map coverage for any area. They may be obtained from the Map Information Office, Geological Survey, Washington 25, D.C.

Federal Surveys and Maps

A recent paper, Federal Surveys and Maps - Accomplishments During 1948, is a resume of the surveying and map compilation projects of the federal government in 1948, which cover a very broad scope of endeavor and include geodetic, geologic, hydrographic, topographic, cadastral, soil, and many other types of surveys as well as map compilation involving innumerable subjects and purposes for both military and civilian use.

The accomplishments of the various producing agencies and those whose main interest is in map research and the maintenance of important map libraries, are presented in this paper. Information regarding federal surveys and maps may be obtained from the Map Information Office, Geological Survey, Washington 25, D.C.

State Coordinates and Polyconic Maps

State Coordinates and Polyconic Maps, Circular 57, 7 pp., May 1949, contains information concerning commonly used map projections. As it is impossible to represent a spheroidal surface on a plane sheet without some distortion, no perfect projection has been devised for mapping the earth's surface.

The polyconic projection which is used for all quadrangle maps of the U.S. Geologica Survey has been accepted generally as the best for a small regular-shaped area. However, there are some advantages in the use of the state plane-coordinate systems on the Lambert and transverse Mercator projections. For example on the latter projections, scale distortion can be computed at any point, a unique relationship exists between grid coordinates and geographic coordinates, and the interchange between these coordinate is relatively easy.

As the state plane-coordinate systems have been designed (with one exception) to have an error not exceeding 1 part in 10,000; and as a polyconic projection of a quadrangle map of 1° extent or less contains so little distortion that it may be considered a true representative of the earth's surface, it follows that map detail may be transferred readily between a polyconic quadrangle map and either of the state coordinate system maps.

More detailed information may be found in Circular 57 which may be obtained free from the Director, Geological Survey, Washington 25, D.C.

Horizontal and Vertical Control Maps

Status of Horizontal Control in the United States, and Status of Vertical Control in the United States, are two index maps, scale 1:5,000,000 which were released in June 1948. These are the first published indices of their kind. One shows the extent of horizontal control (triangulation and transit traverse), the other the extent of vertical control (leveling), both of which have been established by federal agencies in the U.S., its territories, and possessions. The controls made by the U.S. Coast and Geodetic Survey, U.S. Geological Survey, and other federal agencies are distinguished from one another on the map. Most of the control established by the U.S. Coast and Geodetic Survey is on the first-and second-order accuracy. This is used as a basis for the mapping of the U.S. Geological Survey topographic quadrangle atlas which is generally of third-order accuracy.

From these maps vertical and horizontal control in a specific area can readily be determined. These may be obtained from the Map Information Office, Geological Survey, Washington 25, D.C.

BORATES

Although more than 60 minerals containing boron are known, only a few are of commercial importance. Of the salts, borax is one of the most useful and is employed extensively in manufacturing processes and as a household commodity. The water solubility, low melting point, and fluxing properties of borax render it commercially valuable. Formerly obtained in a large part from processing the lime borates, colemanite and ulexite, it is now produced from the sodium borates, natural borax and kernite. The latter are more amenable to treatment, being water soluble.

Boric acid is also a widely used product of borate minerals and salts. It does not occur in large quantities in natural deposits but is manufactured. Some production is obtained from the condensation of volcanic steam in certain parts of Italy.

The development of the modern borate industry in the United States has been in California. New discoveries of borate deposits and technologic advancement in their treatment have resulted in the displacement of one mineral by another. Borates and boric acid were first produced commercially in northern California from spring and lake waters. Borax Lake (Lake County) was the early scere of production from 1864 to 1872. Large deposits of borax and ulexite in marshes and playas of eastern California and adjacent Nevada were worked from 1872 to 1887. From about 1887 to 1926 the development of the extensive colemanite and massive ulexite beds of southeastern California and Nevada marked a tremendous growth of the industry. The extraction of borax from the brines of Searles Lake starting in 1920 and the discovery of the deposits of borax and kernite in the Kramer area in 1926 initiated a new and the most important phase of the industry.

The important commercial borate minerals of the United States are borax, ulexite, colemanite, and kernite. Other boron minerals of minor commercial importance are tincalconite, probertite, meyerhofferite, inyoite, priceite, bakerite, and howlite. Sassolite and boracite are important minerals in foreign countries. About two-thirds of these, when calcined, consist of boron trioxide (Be_2O_3).

Borax, a natural sodium borate ($Na_2B_4O_7 \cdot 10H_2O$) contains 36.6 percent boron trioxide in the mineral and 69.2 percent in the calcined material. It is found as individual crystals (monoclinic), as aggregates of poorly developed crystals, and as compact glassy masses. When pure, it is clear and colorless, but usually it is a dull, earthy white owing to partial dehydration. It can also be gray or some other color, depending upon the enclosed impurities. In hardness, it ranges from 2 to 2.5; its specific gravity is 1.72. The mineral is soluble in cold water and when heated, swells and fuses easily. The efflorescent crystals with habit similar to that of monoclinic pyroxene are characteristic of borax. Borax has been known and used since early times. It has been produced in the crude form from the salt lakes of Kashmir and Tibet and refined in western Europe.

Ulexite is a natural hydrated sodium calcium borate (probably $NaCaB_5O_9 \cdot 8H_2O$) containing 43.0 percent boron trioxide in the mineral and 66.6 percent in the calcined material. It is not found in distinct crystals but in rounded fibrous masses, locally called "cotton balls", and in compact translucent masses. The hardness ranges from 1 to 3 and the specific gravity is 1.96 (not 1.65 as given in some books). The mineral is not soluble in cold water but is partly attacked by hot water and is readily soluble in hot acid. It is distinguished by the soft rounded masses with fibrous structure and silky luster.

Colemanite is a natural hydrated calcium borate ($Ca_2B_6O_{11} \cdot 5H_2O$) with 50.9 percent boron trioxide content in the mineral and 65.2 percent in the calcined product. It occurs in clear, colorless or white monoclinic crystals, in many places as a lining in geodes, and in crystalline and compact granular masses. In hardness, it ranges from 4 to 4.5 and has a specific gravity of 2.42. It is insoluble in water but soluble in hot acid. Exfoliation results from heating. Colemanite is distinguished from most minerals by its perfect cleavage in one direction. Although similar to gypsum, it is identified by its greater hardness.

Kernite, a borate of sodium ($Na_2B_4O_7 \cdot 4H_2O$), contains 51.0 percent boron trioxide in the mineral and 69.2 percent in the calcined material. It occurs in clear, colorless monoclinic crystals or cleavable masses, many of large dimension. Cleavage is perfect in two directions. It is white to gray or colorless, is transparent to translucent, and has a vitreous to pearly luster. The hardness is 2.5 and specific gravity 1.95. Fragments are slowly soluble in cold water but readily so in hot water and acid. It is identified by the cleavage in two directions, inferior hardness, and low specific gravity. Splintery fragments obtained from crushing are characteristic.

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The borate minerals described occur in sedimentary beds, mostly clay and shale, largely derived from volcanic ash and associated with limestone and sandstone. In the United States, the borates have been found in California, Nevada, and Oregon. The major California deposits are in Kern, Inyo, and San Bernardino Counties. Borax and ulexite associated with marsh and playa deposits are found in many localities in eastern California and Nevada. Searles Lake, California, is the only other important source of borax from this type of deposit. The lake brines are 36 percent solids, of which 3 percent is borax. Colemanite, as a lake deposit, is found extensively in Inyo, San Bernardino, Kern, Los Angeles, and Ventura Counties.

The deposits of kernite and borax in the Kramer area of southeastern Kern and western San Bernardino Counties occur as tabular bodies enclosed in shale and clay; they are associated with volcanic tuffs, limestone, and sandstone. These deposits have proved to be the most important source of borax and borate minerals in the world. Produc ion from the area from 1926 to 1946 has been reported to approximate over 2,000,000 tons with an average boron trioxide content of 40 percent.

Commercial deposits of borate minerals have been found in Chile, Argentina, Bolivia, Peru, Turkey, Italy, Germany, and Tibet. The continuous development of the California deposits has adversely affected the development of all other borate deposits in the world.

Mining of the Kramer area deposits in California constitutes one of the largest underground operations of the state. The crude material is either crushed and shipped to a refinery at Wilmington, California, or concentrated for certain products at Boron. At Wilmington, borax is produced by dissolving the crushed material with the aid of heat and pressure and reprecipitating the borax. A new boric acid plant was placed in operation at Boron during World War II. At Searles Lake, the brines are treated at plants at Trona and West End. The process used is essentially one of evaporation followe by fractional crystallization to produce borax, soda ash, potassium chloride, and other saline products. In Italy, boric acid, ammonia, and carbon dioxide are products from the industrial development of volcanic gases for heat and steam.

The greatest consumer of boron minerals has been the glass container industry. Borax used in such products improves the tensile strength, elasticity, and hardness of the glass. Porcelain enamel, used in coating iron and steel for bathtubs, refrigerators, etc., also contains borax as an essential constituent. In the manufacture of pottery, bricks, china, white and colored ceramic ware, glazes and many kinds of glass, borax is indispensable, as it lowers the coefficient of expansion and makes the product more durable. Boron minerals are used in water treatment, soap formulas, pharmaceuticals, and various other commodities. The mild antiseptic character of borax prevents rancidity in cosmetics, pastes, and glues. It prevents formation of mold or mildew in starches and sizes, citrus fruits, leathers, and textiles. The wide use of boron minerals extends to the manufacture of candles, carpets, drug specialties, dyes, hats, inks, oil, jewelry, shoes, stove polish, tobacco, and many others. In agriculture, these minerals have been found to stimulate plant growth and to inhibit the development of certain plant diseases. In 1946 an increased use of boron minerals continued in porcelain enamel, glass containers, fertilizers, synthetic detergents and textiles.

The sale or use of boron minerals by producers in the United States amounted to 430,689 gross tons, containing 129,800 tons of boron trioxide and valued at $9,575,866 in 1946. This increase of about two million dollars in value over 1945 established a new historical record in the boron industry. The price of technical, granular borax, bulk, was from $44.50 to $47.50 per short ton during that year. In April 1949 the price was $57.25 per short ton as quoted by Metal and Mineral Markets of Engineering and Mining Journal.

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MINERAL INFORMATION SERVICE

VOL. 2 October 1, 1949 No. 10

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

FALL MEETING, SOUTHERN SECTION, A.I.M.E.

The fall meeting of the Southern California Section of the American Institute of Mining and Metallurgical Engineers will be held at the Elks Club, 607 So. Park View, Los Angeles, October 20-21. There will be a Petroleum Division luncheon at the Town House, 2961 Wilshire Blvd., on Thursday October 20th and an All-Division luncheon at the same location, Friday the 21st. The Industrial Minerals Division will meet on the 21st; the Mining and Milling Division on the 20th; and the Petroleum and Metals Divisions on both days. William Ver Planck, staff geologist and mining engineer of the State Division of Mines will present a paper on gypsite. Other topics in the Industrial Minerals Division will include fissionable materials, pyrophyllite, South African asbestos, and barium and potash prospecting methods.

AMERICAN MINING CONGRESS CONVENTION

The Western Division of the American Mining Congress will hold its 1949 Metal Mining Convention at the Davenport Hotel, Spokane, Washington, September 26-28. Eight field trips have been scheduled for September 29-30, immediately following the convention. These will include two through various parts of the Coeur d'Alene mining district, Grand Coulee Dam, Trail, British Columbia, etc. The convention program covers all phases of the metal mining industry. Entertainment and trip tickets may be obtained in advance by addressing the American Mining Congress at the Davenport Hotel.

ANNUAL MEETING GEOLOGICAL SOCIETY OF AMERICA

The sixty-second annual meeting of the Geological Society of America will take place at the Cortez Hotel (and adjacent hotels), El Paso, Texas, November 10-12. A large number of papers will be read including a group of seven on Arizona structure. Lauren A. Wright, staff geologist of the State Division of Mines, will present a paper on the "Geology of the Silver Lake Talc-Bearing Area, San Bernardino County, California."

PACIFIC CHEMICAL EXPOSITION

The California Section of the American Chemical Society will open its 1949 Pacific Chemical Exposition at the San Francisco Civic Auditorium, November 1. The exposition will run five days from Tuesday November 1 to Saturday November 5. Running concurrently with the exposition will be a series of industrial conferences of the society including meetings of affiliated organizations. The Petroleum Division of the A.I.M.E. will meet with the Petroleum Division of the American Chemical Society on Tuesday November 1, in Larkin Hall. The State Division of Mines will maintain a booth and exhibit at the exposition featuring industrial minerals, maps, and publications.

EL DORADO COUNTY

General Geologic Features

Northernmost of the Mother Lode counties, El Dorado County is bordered on the west by Sacramento and Placer Counties. It extends from the lower foothills on the west, up the gradually rising slope of the Sierra Nevada to the summit of the range (8,000 to 10,000 feet) thence across Lake Valley to the Nevada State line. Part of Lake Tahoe is included within its limits. It occupies part of the drainage basin of the Middle Fork of American River and the larger part of the area drained by Cosumnes River. The western region was, in Cretaceous time, part of an extensive peneplain occupied by Jurassic and Paleozoic formations; there are no marine deposits younger than the Mariposa (Upper Jurassic) clay slate.

In El Dorado County, the western part of the bedrock complex consists largely of altered igneous rocks derived from basic tuff and other basic volcanic debris. Through dynamic metamorphism, the fragmentary material has been changed principally to chlorite or amphibolite schist. The principal Jurassic metasediments of economic importance are the Mariposa slate beds of the Mother Lode belt which cross the county from north to south by way of Georgetown, Placerville, and Nashville. In the southern part of the county this slate strikes north and is bordered on the west by the Logtown agglomerate, which has been placed as upper Middle to lower Upper Jurassic by Taliaferro. Near Diamond Springs the slate strikes northeast, but north of Placerville it again strikes north-northwest. From Garden Valley northward, the slate is divided into two strands by a large wedge of amphibolite schist. The Mother Lode veins occur in both the slate and schist, as well as along the borders of narrow serpentinized dikes occasionally found in the slate. An important ancient river system, possibly in part as old as the Cretaceous, but mantled by middle Tertiary rhyolite and andesite, crossed the Mother Lode just south of Placerville. It was partly exposed by later erosion and yielded great quantities of gold to the pioneers.

West of the Mother Lode the meta-igneous rocks as well as the Paleozoic metasediments were extensively invaded by gabbrodiorite and granodiorite and by smaller bodies of ultrabasic rocks. The last named have since been serpentinized.

Following profound erosion during the Cretaceous, the birth of the present Sierra Nevada began, accompanied by the rejuvenation of streams in the early Tertiary. Finally, outbursts of rhyolite ash followed by repeated and much more extensive eruptions of andesite came from the mountains to the east. The quantity of the andesite, which descended the slope in the form of mud and breccia, was sufficient to fill entire valleys. Large river canyons and their deposits were thus covered and protected until found by the pioneer gold miners. Modern stream systems established since the end of that volcanic era have stripped off a great deal of the volcanic cover and much of the older metasediments, and have exposed the underlying granitic rocks both east and west of the Mother Lode. Long sections of ancient stream channels were washed out and the gold they contained was again concentrated, this time in the modern streams.

East of the Mother Lode and west of the summit of the Sierra Nevada, the remaining older rocks that only partially cover the granite are Paleozoic (Calaveras formation). The rocks of this Paleozoic complex include clay slate and phyllite, altered limestone and sandstone, quartz-mica schist and graphitic schist, chert, and a variety of altered volcanic rocks, now largely changed to schist. This is the East Belt of the gold miner.

Owing to pressure from the invading granodiorite, all of the older rocks, including the Mariposa and other Jurassic beds on the west, have been closely folded and rendered schistose; the schistosity strikes northwest and dips steeply northeast. Long ridges with gentle westward slopes covered with andesite tuff and breccia extend into the higher mountains east of the Calaveras rocks. In these mountains also are many remnants of Pliocene moraines. Some roof pendants of clay slate and associated augite porphyrite on the eastern slope near Lake Tahoe have been called Juratrias.

Two important faults have been mapped. One is the Mother Lode reverse fault system and the other is the great fault system along the eastern side of the Sierra Nevada, running nearly north through Lake Valley and Lake Tahoe.

Mineral Resources

Until 1917, gold was the most important mineral product of the county. In the period of rising wages and costs prior to 1930, gold production was small, but a sharp revival came with the depression of 1932, and from 1933 to 1943 the county yielded $15,000,000 in gold. The period of extremely high wages and prices since the end of the last war has been unfavorable for gold mining and recovery is only gradual. Prior to 1943, both lode mines and dragline dredges were productive. The dredging land has been quite thoroughly exploited; the acreage of this land was small. The remaining lode mining possibilities are numerous. Gold-bearing veins occur not only in the Jurassic clay slate and schists of the Mother Lode, but also in most of the rocks of the bedrock complex and around the borders of the invading granitic rocks, on both sides of that lode and as far east as Grizzly Flat at an elevation of about 4,000 feet. In this gold-bearing region, approximately 30 miles square, is a great variety of gold deposits ranging from base ore and low-grade auriferous sulfides through the free-milling, medium-grade, slate-quartz ores of the Mother Lode to the specimen gold of the seam diggings and the more complex but often good grade ores of the Paleozoic East Belt rocks

Large deposits of high-calcium limestone, mostly altered to dense, fine-grained marble, occur near Cool, in Marble Valley, near Rattlesnake Bar, and north of Dugans. These Paleozoic deposits have been closely compressed and tilted so that they appear as lenses standing on edge. Two such lenses have been worked to a vertical depth of 800 feet. Magnesian limestone is also quarried east of Diamond Springs for making lime.

More than 40 years ago, chrysotile asbestos was produced from serpentine areas near Georgetown and Greenwood. The county was one of the larger producers of chromite in 1915-18 and some production was made during the last war. Considerable disseminated ore remains which requires further experimental work in concentration before an economic product can be recovered. Copper has been mined in small amounts when price permitted, and one producer has been active recently. Some of the mines and prospects are in amphibolite schist, but many are of contact-metamorphic type, at the borders of granitic rocks. These copper ores carry some gold and silver. Iron ore and scheelite have been mined in only small quantities. Lead and silver are by-products of gold-quartz ores, and small amounts of the platinum-group metals have been recovered with placer gold. Some pyrite was shipped 30 years ago. Silica from veins in White Rock Canyon has been shipped for use in cleaning compounds.

The black slate of the Mother Lode belt between Placerville and Kelsey is excellent for roofing granules and for sawing into slate shapes. From 1895 to 1912 substantial quantities of slate shingles were produced from several quarries there. At present the only use made of this slate is for roofing granules. Numerous soapstone quarries have been worked. Those most recently exploited are located near the railroad in the vicinity of Brandon and Latrobe. Deposits are also known near Shingle Springs, Placerville, and east of Diamond Springs. Sand and gravel are available for local use. White rhyolite ash deposits at Smiths Flat are so far undeveloped.

Significant Activities During 1947

El Dorado County is one of the leading producers of high-calcium industrial limestone in the state. Two modern lime plants are located within its boundaries. At present, the value of these products exceeds half a million dollars annually, and the only close competitor in either tonnage or value of output for this purpose is San Bernardino County. Several counties produce larger tonnages of limestone than El Dorado, but the bulk of it is mined for use in portland cement.

California Rock and Gravel Company operated a large quarry near Cool where a nearly pure high-calcium limestone was produced for beet-sugar refining and other industrial uses. This company also supplied limestone during 1947 to the new plant of Auburn Lime Products Company, 10 miles distant. The latter operated a rotary kiln for making several sizes of lime and also had equipment for crushing and screening limestone for poultry grits, glass, etc. This company's own limestone deposit, which produced stone for lime and other uses off and on since the sixties, is not being worked at present.

At Diamond Springs, the large modern lime plant of Diamond Springs Lime Company utilizes magnesian limestone from its own quarry about 5 miles east of the plant to make lime for plaster, and also burns lime from the underground mine of El Dorado

Limestone Company. The latter company has been producing a very fine quality of white high-calcium limestone from workings that have reached a vertical depth of about 800 feet. They have a washing and hand-sorting plant to raise the grade of the limestone, which goes to steel mills (after being burnt to lime). This limestone is also sold for use in paint, sugar-refining, glass, etc. The limestone deposits of California, including those in El Dorado County have been described in detail in a recent report by Logan. The limestone industry in El Dorado County employs 150 or more men.

Pacific Minerals Company, Limited, operates a crushing and screening plant at Chili Bar on the South Fork of American River where the black Mariposa clay slates of the Mother Lode belt is made into roofing granules for use on "ready roofing" and shingles. The by-product dust and some crude slate are also marketed.

Gold production in 1947 amounted to $104,790 which came from 13 small lode mines and 12 placers. More than $91,000 of this was from placers, principally small dredging operations. Shortage of water in the western part of the county hampered lode mining by the middle of summer, and caused some shutdowns. The Lilyama mine which has copper- and gold-bearing ore, and the Shaw (Volo) mine were worked part of the year. The Grit mine at Spanish Dry Diggings was equipped with a mill and was prospected by Liddicoat Gold Mines Company.

Soapstone is quarried by Pacific Minerals Company, Limited, from a deposit alongside the railroad at Shrub Spur, north of Brandon.

Mineral Production

Product	Quantity	Value
Copper	112,000 pounds	$23,520
Gold	2,994 troy ounces	104,790
Lead	2 short tons	576
Silver	2,039 troy ounces	1,845
Stone	211,780 short tons	483,991
Zinc	6 short tons	1,452
Unapportioned (lime, sand and gravel, slate, and soapstone)	——	1,024,846
Total value	——	$1,641,020

Descriptions similar to the above (more extended for counties that produce more mineral substances) of every county in the state are published in State Division of Mines Bulletin 142, The Counties of California, Mineral Resources and Mineral Production During 1947. Price $1.25 per copy, paper cover.

COURSE IN CERAMIC ENGINEERING FUNDAMENTALS 870AB
DIVISION OF ENGINEERING EXTENSION
University of California

Instructor: Dr. Joseph A. Pask, 15 meetings, fee $18.
Starts: Tuesday, Sept. 27, 1949; 7:30-9:30 p.m.; 210 Hearst Mining Bldg., Berkeley Campus.

Specifically designed for those engaged or interested in the manufacture of the structural clay, refractory and whiteware or pottery products of the ceramic industry. Subjects to be covered are: types of clay and their uses; clay minerals; accessory minerals and their effect on clay usage; other raw materials in ceramics; drying principles and calculations; pyrometry; pyrometric cones; chemical reactions of materials; firing of clay bodies including watersmoking, oxidation, and vitrification periods; melting and fusion of ceramic materials; physical properties of ceramic bodies; types and operation of kilns; fuels and firing calculations.

MINING AND INDUSTRIAL NEWS NOTES

Amador County

Slag from an old smelter site on the Pioneer copper mine in western Amador County has been utilized by the Plymouth Rock Wool Manufacturing Company to make rock wool. The company, owned by W.H. Danzer, operates a small plant at the Plymouth mine. Its product is used for building insulation.

Milling of dump ore was started in mid-August at the Pine Grove gold mine on the Stirneman Ranch near Buckhorn Lodge. The reduction plant, which has a capacity of about one ton per hour, includes a Denver ball mill, Wilfley concentrator and four flotation cells. The mill is operated by electric power, and water for melting is pumped from a shaft 100 feet deep. The operation is being conducted by Associated Metals, Inc., Seattle, with J.T. Bonner of Pioneer Station in charge. Three men are employed.

Work has been temporarily suspended at the Belden Amador mine which has been successfully operated during the post-war period. Plans are being made for opening another ore body which was worked superficially many years ago. The mine was first worked in 1857 and operated through the late 1860's at which time it had a 5-stamp mill and roasting furnace. Belden Amador Mines, Inc., Fort Wayne, Indiana, began work at the mine in 1936 under the management of Mr. Leon Banks of Pioneer Station, since which time it has been the principal gold producer of the East Belt. Ore has been stoped to a little below the 400 foot level and for 400 feet on the strike. The reduction plant contains a March no. 43 ball mill and employs hand sorting, gravity concentration, and flotation.

Modoc County

There has been a renewal of activity of the High Grade district situated in the Warner Mountains near Fort Bidwell. Surface and underground prospecting and development work is being done at the Moonlight mine by Earl Wallace, Russell Powell, and Raymond Powell of Fort Bidwell, who have acquired Wellman Smith's interest in the mine. The surface has been prospected by five bulldozer cuts which run eastward across a shear zone at 50-foot intervals. Several quartz stringers have been uncovered from which free gold has been panned. A new shaft is being sunk in the shear-zone about 85 feet south of the shaft from which high grade ore was mined last year. Four feet of quartz and vuggy rhyolite breccia stained with limonite and carrying free-panning gold crosses the shaft from north to south at a depth of 14 feet.

The Klondyke mine, which is located southwest of the Moonlight group of mines, is being prepared for operation. The milling plant is being remodeled, and prospect pits are being dug by eight mining students from the Colorado School of Mines, who are gaining practical mining experience. A new ball mill and two Humphrey spiral concentrato have been added to the mill circuit. The operation is by Ed Benefiel and associates who have incorporated the Klondyke Mining and Milling Company.

Del Norte County

Rock for building the north jetty of the Crescent City harbor is now being quarried at Point St. George. It is chiefly sandstone and a dark gray igneous rock; both are well suited for the purpose. The rock, which rises to a maximum of 170 feet above sea level at the quarry, is broken by driving coyote drifts and blasting with bags of black powder. Rocks weighing from five pounds to twenty tons are loaded into trucks by power shovels and hauled five miles to the jetty. There the rip-rap is placed mainly by crane. The present contract with Macco, Morrison-Knudson Co., Inc., calls for placing 575,000 tons of rock in the next three seasons. Work is progressing on one ten hour shift. Sixty men are employed under the direction of C.L. McDonald resident manager.

FERRO-ALLOYS

Ferro-alloys are used principally in the production of iron and steel to introduce the alloy metal as a cleansing or deoxidizing agent, or to give the steel certain desired physical properties. They are used also to make alloys with other metals. Much more ferro-alloy is consumed in the iron and steel industry than is used for all other purposes combined.

Ferro-alloys are being used in increasing amounts in making new types of alloys. An example is the growing use of molybdenum alloys for parts of gas turbines, jet aircraft engines, and turbosuperchargers.

Iron, molybdenum, silicon, and vanadium are the only ferro-alloy materials that are supplied exclusively from domestic deposits. Two of the most important alloying metals, manganese and chromium, are obtained almost entirely from foreign countries. Metals not produced domestically are being stock piled by the government to insure availability of these metals if the foreign supply should be interrupted.

Almost all ferro-alloy is made in electric furnaces, although some is made in blast furnaces. In the United States ferro-alloy is produced chiefly near sources of cheap electric power in the east and south. Ferro-alloy plants have recently begun operation in Washington and Oregon, where cheap hydroelectric power is also available. One plant operates intermittently in California at Permanente. The combined ferro-alloy production of New York and Pennsylvania is 60 percent of the total United States production. Other states with records of ferro-alloy production are Alabama, Iowa, New Jersey, Ohio, South Carolina, Tennessee, Virginia, and West Virginia.

Ferromanganese and ferrosilicon are the alloys most commonly used for deoxidizing steel. To a lesser extent silicomanganese, ferroaluminum-silicon, silicon-zirconium, and ferrotitanium are used.

Special physical properties are imparted to steel by the introduction of ferromanganese, ferrosilicon, ferrochromium, ferromolybdenum, ferrotungsten, and ferrovanadium; and to a smaller extent ferrotitanium, ferrophosphorus, and silicon-zirconium. The metals are held in the steel in solid solution or combined as carbides.

California Ferrosilicon

All of the ferro-alloy produced in California has been ferrosilicon, made by the Permanente Metals Corporation at its Permanente plant. During World War II ferrosilicon was made there for use in the production of metallic magnesium. Following the war the decreased demand for its use in this connection, coupled with high power rates, forced cessation of the output. On April 1, 1949, a six months run, producing ferrosilicon containing 75 percent silicon, was begun. Vein quartz, coke, and scrap iron are used at Permanente to make ferrosilicon. The coke and scrap iron are purchased on the market. The quartz is mined at the White Rock silica deposit, Mariposa County, California; this deposit is owned by the Permanente Metals Corporation. It is anticipated that most of the ferrosilicon will be shipped to consumers in the east. The market quotation for ferrosilicon in early 1949 was: per pound of contained silicon, sold in the Eastern Zone, 11.3 cents for 50 percent grade, and 13.5 cents for 75 percent grade.

Principal Ferro-Alloys

Ferrosilicon. At present about 770,000 tons of ferrosilicon is being produced annually in the United States. The iron and steel industry uses most of this output for deoxidizing steel during refining, to increase the resistance of cast iron to corrosion and for the production of high-silicon steel used for electrical and spring steels.

Silicon used in the production of ferrosilicon is derived from quartzite, sand, or vein quartz. Iron used in this alloy is introduced as iron and steel scraps chosen for their low content of sulfur and phosphorus. The reducing agent employed in this process is either charcoal or high grade coke. All of the materials necessary to manufacture this alloy are available in the United States.

Ferromanganese. Several alloys of iron, manganese, and silicon are used to deoxidize and toughen steel products. Approximately 600,000 tons of these ferromanganese alloys are being produced in the United States annually. Most ferromanganese is manufactured in electric furnaces, although some spiegeleisen is produced in blast furnaces.

The raw materials used in the manufacture of ferromanganese are manganese ores containing 45-50 percent manganese, iron, or iron ore, a carbonaceous reducing agent, and slag-forming materials as needed. Somewhat less that 10 percent of the manganese used in the United States is produced domestically. Of the more than 90 percent imported, 35 percent comes from Russia. The ferromanganese market price in March 1949 was $175 per ton for 78-82 percent grade ferromanganese delivered to the seaboard.

Ferrochromium. By the addition of ferrochromium, steel is made harder and more resistant to heat. Ferrochromium is employed also in the manufacture of alloys of chromium with vanadium, molybdenum, and nickel. These alloys are also noteworthy for their resistance to heat and corrosion. More than 100,000 tons of ferrochromium is produced in the United States annually.

Ferrochromium is produced in electric furnaces by the reduction of chromite with carbon. Commonly the ferrochromium contains 65-75 percent chromium, 4-8 percent carbon, and 1-3 percent silicon. Almost all metallurgical-grade chromite used in the United States is imported. Forty percent comes from Russia. Market prices are quoted for carload lots of lump ferrochromium delivered in the eastern zone. The early 1949 price for high carbon (4-9 percent carbon) ferrochromium containing 65-69 percent chromium, was 18.6-20.5 cents per pound.

Ferromolybdenum. Ferromolybdenum is a constituent of steel used by the aircraft and automobile industries. Alloy steels containing molybdenum are noteworthy for their strength at high temperatures. During 1948 molybdenum in the amount of 8,500 tons was consumed in the United States for the production of ferromolybdenum, molybdic oxide, and in molybdenum salts and metals. Domestic production of molybdenite and ferromolybdenum is sufficient to meet the demands of American industry.

Ferrotungsten. Ferrotungsten, made in small electric furnaces, is used in the manufacture of high-speed tool steel and other alloys. Tungsten minerals, wolframite, ferberite, and scheelite, are smelted in contact with carbon, iron ore, or scrap iron, and suitable slagging materials. About half of the tungsten consumed by the United States is produced domestically.

Ferrovanadium. Steel containing vanadium has the property of being resistant to the effects of shock and vibration. Ferrovanadium is made in electric furnaces by smelting ore concentrates high in vanadium oxide with a carbonaceous reducing agent, iron, fluxes, and silicon. At present, domestic producers are able to supply all United States demands for vanadium.

Ferrotitanium. Just before casting molten metals, ferrotitanium and ferrocarbon-titanium are added as scavengers. Other less common iron-titanium alloys contain varying amounts of carbon, silicon, and aluminum. The largest United States producer of ilmenite, the most abundant titanium mineral, is at Tahawas, New York. Of the ilmenite consumed in the United States, 40 percent is imported. The chief foreign sources are India and Norway.

Ferrocolumbium. Ferrocolumbium is added to stainless steel to improve weldability, creep strength, and impact strength. It also improves the resistance of steel to oxidation at high temperature and reduces intergranular corrosion. Some colombium is produced in the United States, but 99 percent of the world's columbium is produced as a by-product of placer tin operations in Nigeria.

Miscellaneous Ferro-Alloys

Ferrophosphorus. Iron-phosphorus alloys are added to sheet steel to prevent them from sticking together during annealing. The addition of this alloy imparts free-cutting properties to steel pipe.

Ferroboron. Ferroboron ordinarily contains 15-25 percent boron. The addition of ferroboron helps harden, deoxidize, and degasify steel.

Ferrocobalt. Cobalt added to steel, as ferrocobalt or metallic cobalt, reduces the hardenability. Cobalt is used in high-speed steel and permanent magnets.

Ferroaluminum. This alloy, which is 20-50 percent aluminum, is used in steel processing. However, more commonly the aluminum is added as metallic aluminum or an aluminum-silicon-iron alloy.

Simanal. This alloy commonly contains 20 percent silicon, 20 percent aluminum, 20 percent manganese, and 40 percent iron. It is used in steel refining to deoxidize and assist in controlling grain size.

Ferroselenium. Ferroselenium is added to steel to improve its machinability.

Manganese Briquets. Most manganese briquets contain 57 percent manganese. These briquets are used in iron founding to counteract harmful effects of sulfur and to deoxidize and scavenge molten iron.

Alsifer. This alloy is made by adding molten aluminum to ferrosilicon. It is used for final deoxidation and control of grain size.

Calcium Silicon. This alloy is used in steel refining to deoxidize, to degas, and to increase fluidity of molten stee.

Molybdenum Silicide. Alloys of this type contain about 1 percent iron, 60 percent molybdenum, and 30 percent silicon. It is used to advantage for adding molybdenum and silicon to steel simultaneously.

Zirconium. Silicon-zirconium and zirconium-ferrosilicon, when added to steel, produce sounder and cleaner metal. Steels containing zirconium possess good hot-working properties.

Ferronickel. An iron-nickel alloy containing 36 percent nickel is called invar and is noteworthy for its low coefficient of expansion. Metallic nickel is added to chromium steels to increase their resistance to corrosion and heat. Alloys of nickel and iron are used for magnets.

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PRODUCTION AND UTILIZATION OF PETROLEUM IN CALIFORNIA FOR FIRST HALF OF 1949 COMPARED WITH THE FIRST HALF OF 1948

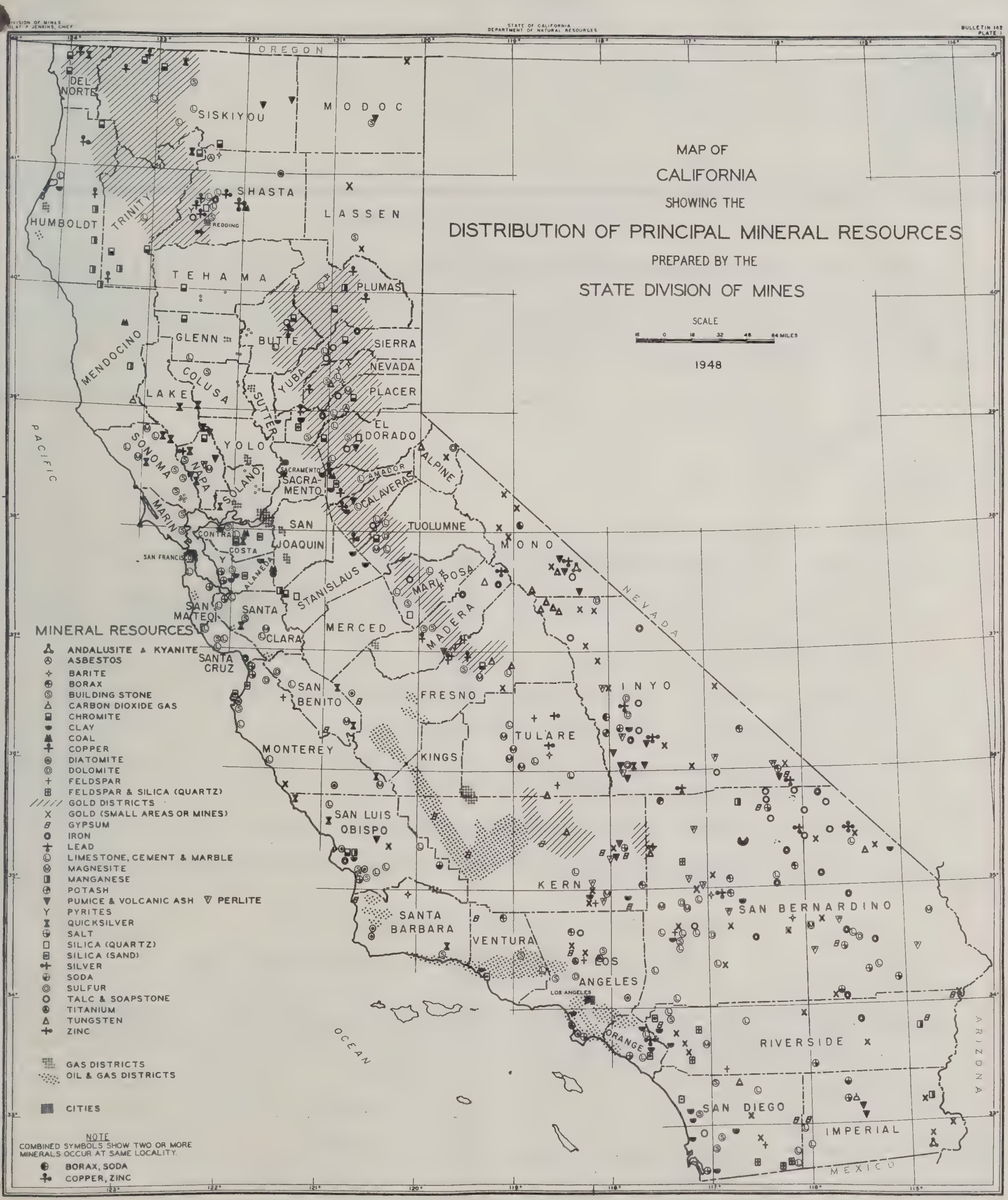
Crude petroleum produced in California from January through June 1949 according to figures released by the United States Bureau of Mines, 1949, totaled 169,746,000 barrels as compared with 171,174,000 barrels produced during the same period in 1948; 1,520,000 barrels were shipped into the state as compared with 747,000 barrels shipped during the same period in 1948. During the first half of 1949 (Jan-June) 165,395,000 barrels of petroleum were sent to the refineries; 1,042,000 barrels were transferred from crude to fuel oil; 3,236,000 barrels were shipped out of the state; and stocks were increased by 833,000 barrels. Compared with this, the first half of 1948 shows 166,573,000 barrels were sent to the refineries; 676,000 barrels were transferred to fuel oil; 3,210,000 barrels were shipped out of the state; and stocks were increased by 844,000 barrels.

Most of the crude oil produced in California is sent to storage reservoirs at tank farms near the oil fields and from these reservoirs by pipe lines to the refineries. The larger of the refineries are located in the vicinity of Los Angeles and in the San Francisco Bay area.

Output of Petroleum Products For First Half of 1949 and First Half of 1948 (Jan-July)

Refinery input and transfers	1949 Barrels of 42 gal.	1949 Barrels of 42 gal.
Crude petroleum	165,395,000	166,573,000
Condensate	1,581,000	1,793,000
Natural gasoline	8,181,000	7,853,000
Liquefied petroleum gases	2,082,000	1,679,000
Total refinery input	177,239,000	177,898,000
Production and transfers		
Gasoline and naptha distillates	66,703,000	64,108,000
Kerosine and kerosine distillates	2,317,000	1,835,000
Lubricating oils, greases and distillates	2,336,000	2,137,000
Stove oil and diesel oil	26,050,000	25,132,000
Fuel oil	69,828,000	70,659,000
Asphalt and road oil	4,774,000	4,595,000
Coke and other finished products	1,531,000	1,623,000
Refinery gas and shortage	4,667,000	5,944,000

Pacific Minerals Company slate quarry and crushing plant on the American River north of Placerville. The slate is used for roofing granules.


IVISION OF MINES
LAF P JENKINS, CHIEF
STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
BULLETIN 142
PLATE I
MAP OF
CALIFORNIA
SHOWING THE
DISTRIBUTION OF PRINCIPAL MINERAL RESOURCES
PREPARED BY THE
STATE DIVISION OF MINES
SCALE
16 0 16 32 48 64 MILES
1948
MINERAL RESOURCES
ANDALUSITE & KYANITE
ASBESTOS
BARITE
BORAX
BUILDING STONE
CARBON DIOXIDE GAS
CHROMITE
CLAY
COAL
COPPER
DIATOMITE
DOLOMITE
FELDSPAR
FELDSPAR & SILICA (QUARTZ)
GOLD DISTRICTS
GOLD (SMALL AREAS OR MINES)
GYPSUM
IRON
LEAD
LIMESTONE, CEMENT & MARBLE
MAGNESITE
MANGANESE
POTASH
PUMICE & VOLCANIC ASH
PERLITE
PYRITES
QUICKSILVER
SALT
SILICA (QUARTZ)
SILICA (SAND)
SILVER
SODA
SULFUR
TALC & SOAPSTONE
TITANIUM
TUNGSTEN
ZINC
GAS DISTRICTS
OIL & GAS DISTRICTS
CITIES
NOTE
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ECONOMIC MINERAL MAP SERIES

Several years ago the California State Division of Mines initiated the publication of a series of economic mineral maps of California, scale 1:1,000,000, each map showing the distribution throughout the state of a particular mineral commodity. These maps, approximately 3' x 3½', show geologic contacts in black, and have a red overprint showing distribution of mineral deposits. Six have been issued so far, on quicksilver, oil and gas, chromite, tungsten, manganese, and copper.

Olaf P. Jenkins, Chief
State Division of Mines
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Please send me:

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MINERAL INFORMATION SERVICE

VOL. 2 November 1, 1949 No. 11

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

FALL MEETING AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

The twenty-sixth joint annual fall meeting of the Pacific Section of the A.A.P.G. will be held Thursday and Friday, November 17-18 at the Ambassador Hotel, Los Angeles. The A.A.P.G. luncheon will be held Thursday, November 17, in the Embassy Room; the Society of Exploration Geophysicists will have their program on Thursday and their luncheon on Friday, both in the Colonial Room; the Society of Economic Paleontologists and Mineralogists will hold their usual dinner meeting on Thursday night in the Gold Room.

MINING AND INDUSTRIAL NEWS NOTES

Amador County - El Dorado County

The Copper Hill copper-zinc mine with properties in the northwestern corner of Amador County and in El Dorado County is being unwatered for exploratory purposes. Production at this mine dates from the 1860's and some ore was shipped from it during World War I.

Calaveras County

A selected flotation plant of 50 tons daily capacity was opened in May 1949 and is now in operation at the Penn mine near Campo Seco. The No. 3 shaft was unwatered to the 700-foot level and ore is being taken from the 500-foot level. Zinc predominates in the ore coming from these workings although the mine has been principally a copper producer in the past. In addition to copper and zinc, the ore carries lead, gold, and silver. Separate copper and zinc concentrates have been shipped but it is planned to make a bulk concentrate in the future. An attempt is being made to eliminate high smelter and freight rates by treating concentrates on the mine property. A pilot plant is being erected and is expected to be in operation during October. An effort will be made to separate the five metals from their sulfides and from each other and obtain them in marketable form. C.F. Fish, E.J. Harp, and Elmer von Glahn are the operators with Harold Hanson as superintendent and A.D. Hadsel as consulting engineer. Eighteen men are employed.

Siskiyou County

The Siskon Mining Corporation is prospecting an extensive gossan outcrop in the Dillon Creek area of Siskiyou County, southwest of Happy Camp. An access road five miles long has been built from the Dillon Creek road to the campsite and continued for two miles over the property. Gold and copper minerals occur in a quartz gangue together with iron pyrite in shear zones which trend northwestward. The deposit is being prospected by trenching with a bulldozer and by diamond-drilling. Thirty men are employed under the supervision of Frank Kanig. Hugh Wright of Happy Camp is general manager for the company.

LEAD

Lead is a very malleable and somewhat ductile metallic element. It is gray in color, soft (H.-1.5) and heavy (G.-11.4). Rarely occurring native, it is obtained from the ore minerals galena (PbS), cerussite ($PbCO_3$), and anglesite ($PbSO_4$). Minor ore minerals are wulfenite ($PbMoO_4$) and pyromorphite $[(PbCl)Pb_4(PO_4)_3]$.

Galena, the most important source of lead, is one of the most distinctive and easily recognized of ore minerals. It is brittle and displays prominent cubicle cleavage on broken surfaces. Galena is soft enough to be easily scratched with a knife and is quite heavy, having a specific gravity of 7.5. Fresh surfaces are a bright, metallic gray in color; weathered surfaces are dull grayish black. When pure, the mineral contains 86.6% lead.

Cerussite is an alteration product of galena usually found in the oxidized zone. The mineral is white, gray, grayish-black or brown in color; adamantine, resinous, vitreous, or sub-metallic in luster; tabular or prismatic in crystallization; brittle as to tenacity; medium in hardness (H.-3.3); and high in specific gravity (G.-6.46-6.57). Crystals are commonly grouped in clusters or aggregates in massive or compact form; occasionally it is fibrous. When pure, cerussite contains 77.5% lead.

Anglesite is also an alteration product of galena in oxidized zones. Crystallizing in the orthorhombic system, the crystals are somewhat tabular, but more often are prismatic in habit. Anglesite is also massive, granular, or compact, is softer than cerussite (H.-2.73) and is brittle. The specific gravity is 6.3-6.39; the color is white gray, or brown (usually with an adamantine luster); and the streak is uncolored. When pure, anglesite contains 68.3% lead.

A simple rapid test suitable for most lead minerals can be made in the following manner: put a liberal pinch of the finely ground ore in a glass beaker and add several drops of concentrated nitric acid; allow the acid to act for several moments and then add two tablespoonfuls of water and a small pinch of potassium iodide (KI). If lead is present, a yellow precipitate will form.

California lead deposits are commonly associated with intrusions of igneous rocks which have invaded limestone or dolomite. Ore bodies have been found at the juncture of igneous intrusions and country rock, as bedding plane replacements in limestone or dolomite, and as fissure fillings. Where ore bodies outcrop on the surface, they are usually rather thoroughly oxidized for some distance below the surface. Outcrops commonly consist of iron-stained quartz, cerussite, and/or anglesite. Cerargyrite (AgCl or horn silver) is a common mineral in oxidized lead zones where it forms from the breakdown of silver-bearing galena. Nearly all galena contains some silver, and some contains a great deal. When silver-bearing galena is oxidized to cerussite or anglesite, the silver also is oxidized and is either carried down in solution and redeposited (secondary enrichment), or may be immediately reprecipitated as horn silver (especially in arid climates).

California's total lead production, since the metal was first mined in the state in the 1860's, has amounted to about one-half of one percent of the national total. However, in recent years California's annual production has been about two percent of the national figure. The 1948 estimated lead production in California was 17,680,000 pounds valued at $3,940,000.

The Cerro Gordo District in Inyo County has been the state's principal lead producer and is credited with a lead, silver, and zinc production in excess of $17,000,000. Ore bodies in this district occur as replacements along fractures in limestone. Most of the lead production was obtained prior to 1877, but the mines have been intermittently worked up to the present time.

At the present time the leading producer of lead in the state is the Darwin District, also in Inyo County. Lead was discovered in this area in the 1870's, and over $7,000,000 in lead, zinc, and silver has been produced there. About half this amount was produced before 1900. The ore bodies occur in a series of impure limestones that have been intruded by a stock of quartz-diorite. The property is now operated by the Anaconda Copper Mining Company, which also operates in the Tecopa District in Inyo County.

Occurrences of lead are widespread in California, and lead production has been reported from 32 counties. Lead is often associated with the complex copper-zinc ores of the Shasta copper belt.

Most of the lead ore produced in California is sent to Utah for smelting. The Selby smelter of the American Smelting and Refining Company, situated on San Francisco Bay in Contra Costa County, accepts lead ore, but the remote mines of Inyo County find it more convenient to ship their ore out of the state. The copper-zinc-lead ore of Shasta County is not acceptable by the Selby smelter because of the zinc content. Consequently, the Selby smelter operates principally on imported ore. Being the only primary lead smelter in the United States situated on tide water, it is in a favorable position to compete on the open market for raw materials. A major portion of the tonnage treated at Selby is received by water from ports all over the world.

Lead smelting as it is commonly practiced today is a three stage process involving: (1) Roasting the ore to remove some of the sulfur; (2) Sintering to eliminate more or the sulfur and to agglomerate the ore; (3) Reduction of the ore with carbon in a blast furnace. About 95 percent of the original lead content of the ore, together with the precious metal content, is recovered as lead bullion by this process. The lead bullion is then refined and the precious metals recovered by a sequence of fire refining methods.

Lead has a number of unusual physical qualities which make it an extremely useful metal. Its extreme resistance to corrosion, ease of fabrication, low smelting temperature, high boiling temperature, and high specific gravity all combine to make it unique among metals. Because of the relatively low temperature required to smelt lead from its ores, it was probably one of the first metals, with the exception of naturally occurring metals, to be used by man.

At the present time the largest single market for lead is in storage batteries. In 1948, 33 percent of the national lead consumption, amounting to 375,000 tons, was used in the manufacture of storage batteries. Because of its high corrosion resistance, a large percentage of the lead used each year is recovered for secondary use. For the past several years production of secondary lead in the United States has surpassed the output of the domestic mines. Storage batteries constitute the largest source of scrap lead.

Other principal uses of lead in 1948 and respective percentages of the national consumption were as follows: cable covering 15 percent, tetraethyl lead 7.5 percent, pigments 10 percent, and solder 6 percent.

Antimony is quite frequently alloyed with lead for the purpose of hardening it. Such an alloy may contain up to 25 percent antimony and is used where the metal will be subject to wear or mechanical injury. Typical applications of a lead-antimony alloy would be in storage battery grids, lead pipes, bearing metal, cable covering, and sheet lead.

Considerable quantities of lead go into pigments and tetraethyl lead for anti-knock gasoline. This lead naturally is not recoverable for secondary use. The recent increase in the consumption of pigments has not affected lead consumption, as a number of non-lead-bearing pigments, such as lithopone, are being substituted for lead pigments.

After reaching an all time high of 21½¢ a pound in late 1948 and early 1949, the price of lead is now down to 14½¢ a pound.

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CHROMIUM

Chromium is a metallic element resembling iron but taking a much more brilliant polished surface. The metal is far less subject to oxidation than iron, and is commonly used as a plating material to cover iron and copper-alloy surfaces both of which tend to tarnish under ordinary atmospheric conditions. Chromium has an atomic weight of 52.01; sp. gr. of 7.1 at 20° C; valence of 2, 3, or 6; and melting point of 1615° C.

The only two chromium-bearing minerals having a wide distribution and likely to be concentrated in economic quantities are chromite ($FeO.Cr_2O_3$) and crocoite ($PbCrO_4$). Crocoite is sometimes a prominent vein mineral in oxidized lead ores, but is seldom utilized as a source of chromium. Chromite is the source of nearly all of the world's supply of chromium.

Chromite, a heavy black to brownish-black mineral with a submetallic luster, resembles magnetite and specular hematite, but is distinguished from them by its brown streak. A common field test is to bruise the specimen with a hammer or pick and to note its streak. Magnetite has a black streak and hematite a red streak. Chromite is always associated with the more basic intrusive rocks such as peridotite, pyroxenite, and dunite or with their alteration products, serpentine and talc. It occurs in pods, lenses, bunches, nodules, and stringers, or banded and disseminated. Most of the deposits are thought to be formed by early segregation of the chromite in the magma. Chromite is ferrous chromium oxide ($FeO.Cr_2O_3$) with varying amounts of aluminum, calcium, iron, magnesium, and silica, which reduce the grade of ore. It resists weathering and accumulates in placers and beach sands in areas where the ultrabasic rocks outcrop. There are markets for three grades of chromite:

(1) Metallurgical grade requires ore that contains a minimum of 48 percent Cr_2O_3 with a chromium-to-iron ratio of 3 to 1 or higher, and is hard lumpy material of which not more than 15 percent passes through a ½-inch screen. Some fines or concentrates may be used as part of the raw material in the manufacture of low-carbon ferrochrome. Silica is undesirable, and some consumers are reluctant to use an ore whose combined magnesia and alumina content is more than 25 percent. Imports of metallurgical chromite amounted to 930,000 tons in 1948. The supply was 2½ times the rate of consumption. The main supply of metallurgical grade estimated to exceed 400,000 tons was imported from Russia. Turkey was the second largest supplier, furnishing about a quarter of the total, Southern Rhodesia, the next largest, followed by South Africa and New Caledonia.

(2) Refractory grade consists of ores having a combined Cr_2O_3 and Al_2O_3 content of 57 percent or more. The silica content should not exceed five percent and the material must be in a hard, lumpy form. Standard refractory ores carry about 33 percent Cr_2O_3, 17 percent MgO and 10 percent iron, with silica as low as 2 percent. Imports were estimated at 440,000 tons in 1948. The Philippines furnished more than a third and Cuba about one-fourth of the total. A small amount came from Rhodesia, Turkey, and South Africa.

(3) Chemical grade chromite should contain a relatively high percentage of Cr_2O_3. The silica content must be low, but a low chromium-to-iron ratio is not harmful, and the concentrates and fine material are preferred. Although considerable quantities of ores containing 48 percent Cr_2O_3 or higher have been used in the chemical industry, the most important chemical ore comes from the Transvaal and carries 44 percent Cr_2O_3, has a chromium-to-iron ratio of about 1.6 to 1, and contains 4 percent silica, 15 percent alumina, and 9 percent MgO. The Ore is usually in the form of run-of-mine fines with only occasional lumps. Receipts of chemical grade chromite were 180,000 tons, most of which came from South Africa.

Although the grades were named for the major uses, some interchange of grade is possible. An appreciable quantity of chemical grade ore has been used for metallurgical purposes, metallurgical concentrates and fines have been used for chemical purposes, and metallurgical lump ore has been used for refractory purposes.

In 1948, about 855,000 short tons of chromite were consumed in the United States. Approximately 44 percent (380,000 net tons) was used in the manufacture of chromium alloys, 38 percent (325,000 tons) in refractories, and 18 percent for other purposes. The largest amount of chromite is used to make ferrochromium for the manufacture of stainless steel and chrome-steel alloys. There is no completely satisfactory substitute for chromium in stainless and other alloy steels, but some chromium can be replaced by molybdenum and manganese. Ferrochromium is manufactured in electric arc furnaces. The addition of even a small amount of chromium to steel results in greater hardness and tensile strength with little loss in ductility. In addition, the hardening can be obtained to a greater depth, which is a great advantage in the manufacture of armor plate and armor-piercing projectiles. The great strength of chrome steels allows reduction of weight of metal used in automobiles, airplanes, and trains. Consumers reported using 93,227 tons of ferrochromium in the first nine months, a rate of 124,300 tons per year for 1948 compared with 113,491 tons for all of 1947. Stainless steels, containing 18 percent chromium and 8 percent nickel are non-corrosive, tough, hard, and strong. Special chrome alloys, such as stellite, containing also tungsten, molybdenum, and cobalt, yield hard, high-speed tool steel. Chromium plating has largely replaced nickel plating. It provides a hard bright surface which resists the corrosive action of ammonia, hydrogen sulphide, and nitric acid, and which is not attacked by molten brass, tin, or zinc.

Chromium alloys are used in the manufacture of exhaust valves, gas turbine blades, pump rods, roller bearings, electric heating elements, and cooking utensils. Refractory ores are used to make chrome bricks used in lining steel and copper furnaces and in repairing basic furnace linings. The principal chromium chemicals are sodium bichromate, sodium chromate, potassium bichromate, potassium chromate, and chromic acid. They are widely used for dyeing, tanning, bleaching, pigments, and oxidizing agents.

Some chromium is recovered from scrap, the major problem being the sorting of chromium-bearing scrap from other scrap so it can be used in the manufacture of chromium steels.

Domestic production of chromite in 1948 increased over 1947 but total shipments from mines are estimated at only 3,500 tons, all of metallurgical grade.

In California, chromite occurs in the serpentine belts of the Coast Ranges, the Klamath Mountains, and in the northern Sierra Nevada. Most of the properties mined during the war were small and they were closed down when the Metals Reserve Company purchase depots for small lots of strategic minerals were closed in 1945. Most deposits were mined by hand methods in open pits. The few deposits mined by underground methods required heavy timbering and were costly to operate. The French Hill mine in Del Norte County was the principal producer during the war and has since continued in production. It was converted into an open pit operation in 1947 by removing the serpentine overburden from the chromite lenses with water from hydraulic giants.

Most of the chromite mined was hand sorted and shipped without milling. Some ores having a high chromium-to-iron ratio were concentrated to a satisfactory grade. In 1942 the beach sands off the southern coast of Oregon were concentrated by Humphreys spiral concentrators followed by magnetic separators. The greater part of our domestic reserves, however, can be utilized for metallurgical purposes only by accepting substandard material or by raising the grade with chemical or electrolytic treatment of the ore or concentrates. The chromite in most of the deposits has too low a chromium-to-iron ratio to yield a standard usable product by mechanical means of concentration.

The United States Bureau of Mines is studying the characteristics of chrome alloy steels made in their pilot plant at Shasta Dam. They are using electrolytic chromium with sponge iron made from magnetite mined in Shasta County.

Prices quoted in E & M J Metal and Mineral Markets for May 26, 1949, ranged from \$20 for 44 percent Cr_2O_3 with no chromium-to-iron ratio specified, to \$41.50 for Turkish ore having 48 percent Cr_2O_3 and a 3 to 1 ratio. Domestic ore, 48 percent Cr_2O_3, 3 to 1 ratio was quoted at \$39 per ton on cars, nearest shipping point. All quotations were for long tons.

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The references listed below are available for study in the Library of the Division of Mines, but are not on sale by the Division.

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Western Refractories Company's Solari pit south of Ione. Main working face showing 38-foot overburden of yellow gravel and buff clayey sand, lying on 20 feet of red and white refractory sand. The refractory sand is a quartz-clay mixture mined for use in fire brick.

N. Clark and Sons Division, Pacific Clay Products Company's Dosch pit west of Ione. This is the oldest active clay pit in California and has been in continuous production since at least 1864. The clay is shipped to Alameda for use in all types of heavy clay products and refractory brick.

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QUADRANGLE GEOLOGIC MAP SERIES

For several years the California State Division of Mines has been publishing a series of quadrangle geologic maps and reports. The maps include a lithograph colored geologic map on topographic base, scale 1:62500, similar to the folio maps once issued by the U.S. Geological Survey; and an economic mineral map, scale 1:62500, showing by red overprint on topographic base the mineral deposits within the quadrangle. The reports describe the typical features of the respective quadrangle and includes a description of its economic mineral resources. Maps are included with the report or may be purchased separately.

Olaf P. Jenkins, Chief
State Division of Mines
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_____ copies of Bulletin 140, Geology of the Tesla quadrangle, California, by Arthur S. Huey. Paper-bound, @ $1.50 ☐ ; cloth-bound, @ $2.25 ☐.
_____ copies of Tesla quadrangle maps, @ $0.75.

The following maps are available, but the reports are still in press.

_____ copies of Hollister quadrangle geologic map, by N.L. Taliaferro, @ $0.75.

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MINING AND INDUSTRIAL NEWS NOTES

Los Angeles County

Development and exploitation of the Don claim of the Hi-Grade gold mine, situated in Mint Canyon, is progressing satisfactorily. Arthur Lueck of Hollywood has a lease on a block which covers 300 feet along the strike of the vein and is 600 feet in width. The lessee and three men are engaged in deepening an old shaft, this operation having reached a depth of 50 feet the first week in October. They expect to continue sinking the shaft to 65 feet at which point a drift will be driven southward on the vein. So far, exposures of the gold-bearing vein in the shaft range in width from 12 to 22 inches. Ore will be treated in the Hi-Grade mill, capacity of which has been increased to approximately 20 tons per day.

Trinity County

A dredge designed for recovery of gold is now in operation on Stuarts Fork of the Trinity River about half a mile below Minersville. It is operated by the Fairview Placer Company and was purchased from the Junction City Mining Company last fall. The dredge has been completely rebuilt and numerous changes have been made in dredge design. The barge has been enlarged by adding six pontoons, and the digging ladder has been lenghtened 8 feet. There are now 77 buckets of 10 cu. ft. capacity driven by a "V" belt from a 300 h.p. motor. The most important change in operation is the installation of eight Yuba placer mining jigs to recover the gold. These jigs are of pulsator type with pulsators on opposite sides of each cell. The jigs are expected to reduce the loss of gold caused by packing of the sluice riffles with black sand. The company has built a modern camp consisting of 16 dwellings for its employees. Harry B. Murphy of Boise, Idaho, and Lewiston, California, is general manager of the Fairview Placer, and Harold C. Young of Lewiston is superintendent of operations. The dredge is operated three shifts per day and 23 men are employed.

TWO NEW COLOR MOVIES ADDED TO DIVISION LIBRARY

The California Division of Mines Library has recently added two 16 mm. color films to its collection. "Prospecting for Petroleum", a 23-minute motion-picture portrayal of the search for oil, and "Birth of an Oil Field", 30 minutes in length, were acquired through the courtesy of the Shell Oil Company, Inc. These two films, both with sound, are available for loan or showing to organized groups. Two other 16 mm. sound films, also in color, are available: "Ghost Towns", the story of the gold-rush days, and "California and its Natural Resources". Each of these is 45 minutes in length.

QUARTZ

Quartz, composed of silicon dioxide (SiO_2), is a very abundant mineral, comprising more than 12 percent of all rocks in the crust of the earth. Common quartz is either colorless or white, although impurities may impart other colors to it. Various colored varieties of quartz, such as amethyst, citrine, plasma, cat's eye, and aventurine, are used for gemstones. Quartz has a hardness of 7 on the Moh scale, and will easily scratch common glass. Crystals of quartz, occurring as hexagonal prisms, are quite common. Quartz has a conchoidal fracture and no cleavage and, therefore, can easily be distinguished from the cleavable feldspars. It is very resistant to all types of chemical and physical weathering, and makes up a large percentage of most sandstones.

Quartz is an essential constituent of a great many igneous rocks, including common granites, quartz diorites, dacites, and rhyolites. Large veins of almost pure quartz are found in the vicinity of intrusive igneous quartz-bearing rock. Many such veins carry valuable metallic minerals as well as quartz. Granite pegmatite dikes are a source of large, well-formed, clear quartz crystals. These dikes are also found in the vicinity of large granitic bodies, and are characterized by large, well-formed crystals of many types. Quartz is also a prominent constituent of many metamorphic schists and gneisses.

Despite the abundance and wide distribution of quartz, the bulk of it is not economically exploitable.

The uses of quartz are many and extremely varied, as follows:

To be suitable for optical use, quartz must be free of all discoloration, feathers, bubbles, cracks, twinning, or inclusions. Single crystals weighing at least 2 pounds are the most desirable, although smaller ones have a limited use. The crystals may be rounded or waterworn, and surface staining is not objectionable, providing the interior is water-clear. The most important single use of optical quartz is in the construction of white-light saccharimeters for determining the concentration of sugar solutions. These instruments are used in controlling sugar manufacturing processes and determing the custom duties to be imposed on import sugar. Large crystals of optical grade quartz have been found in the gold-bearing Tertiary channels of the Sierra Nevada, especially in the vicinity of Mokelumne Hill. These crystals are not particularly water-worn for placer material, and evidently were not transported very far; the source has not been found. In the years 1897-98 more than 12 tons of clear quartz crystal were taken from this locality. One giant crystal removed during this period weighed more than one ton. This channel was again mined during the recent war for quartz crystals of electrical grade. At the present time quartz crystals for optical and piezo-electric use sell for $4.50 to $50.00 per pound, according to size and grade.

Quartz for Piezo-Electrical Use

Anisotropic crystals such as quartz have the peculiar property of developing electrical charges on their surfaces when subjected to strain. This phenomenon is put to practical use in crystal controlled oscillators for radio transmitters, and in controls for high-quality radio receivers. Such electrical devices are made by cutting thin slices from properly oriented quartz crystals, and mounting them in holders. The specifications for electrical grade quartz are practically the same as those for optical grade, with the exception that a yellow or light smoky color is permissible. The only California production of electrical grade quartz has been from the Mokelumne Hill area.

Fused Quartz Glass

For certain uses such as mercury tubes for ultra-violet ray transmission, X-ray and Roentgen tubes, lenses, prisms, cubes, and chemical glassware, clear rock crystals are fused to produce a silica glass. Fused quartz has a higher dielectric value than most common insulating materials, and a plate 1 millimeter thick will insulate an electric potential of 10,000 volts. Fused quartz glass is made in two grades, opaque and clear. Opaque quartz glass can be made from pure silica sand, but clear rock crystal is needed to make clear fused quartz glass. These crystals must be water clear and free from all impurities. Twinning is permissible. The current market price for rock quartz of fusing grade is from $100.00 to $150.00 per ton.

Quartz Glass Sand

All common commercial glass is made from various grades of silica sand. Depending on the type of glass desired, these sands must contain from 95 to 99.8 percent silica (SiO_2). Iron is the most objectionable impurity; the maximum allowable iron oxide (Fe_2O_3) is seldom over one percent, and for colorless glass never over 0.06 percent. Deposits of high-grade silica sand are rare in California, but large reserves of low-grade sand which can be made suitable for glass making by processing are known.

Ferro-Silicon

At the present time about 770,000 tons of ferro-silicon are being produced annually in the United States. This material contains from 15 to 90 percent silicon and is used principally in steel manufacturing. The silicon is derived from quartzite, vein quartz, or sand. Vein quartz for ferro-silicon has been mined in Mariposa County, California. Quartz for ferro-silicon manufacture should contain 97 percent or more silica (SiO_2), not more than one percent iron oxide (Fe_2O_3), and be free from lime, phosphorus, and arsenic.

Fluxing Quartz

It often happens that a smelter treating basic ores, especially copper ores, must buy quartz to add to the furnace charge. This quartz should be low in lime, magnesia, and iron, but metal values in gold, silver, and copper are desirable.

Refractories

Crushed quartz and quartzite and high-grade silica sand are used for refractory linings in various furnaces and converters. These linings may consist of crushed quartz held together with a bonding agent, or prepared silica brick. The percentage of silica, and the allowable quantities of iron and lime depend upon the type of furnace. Recent quotations for silica brick were $80.00 per thousand at eastern factories.

Filler

Large quantities of crushed and pulverized quartz are used as fillers in paper-pulp, cement, plaster, hard rubber, and in other materials. The principal requirements are that the quartz be uncolored and low in iron and alumina (Al_2O_3).

Ceramics

One of the largest and most important uses of quartz is in the manufacture of whiteware and enamel. Metallic compounds are particularly objectionable in quartz for this use. Small amounts of alumina are permissible.

Abrasives

Quartz is utilized as an abrasive in a number of different ways. Grindstones, pulpstones, burrstones, millstones, and whetstones are fabricated from naturally occurring silica sandstones. The demand for these articles, however, has been diminishing in recent years owing to the increased use of manufactured abrasives. Crushed and graded quartz is used to make a poor grade of sandpaper. Linings for tube-mills which grind material that must be kept free of iron are usually made from slabs of quartzite or chert. Such material must have an even texture and be hard and tough. Sand-blasting sands, consisting chiefly of quartz, are widely used. Quartzite pebbles are often used for grinding-pebbles in tube-mills.

Moulding Sands

California has an adequate supply of all types of moulding sand except high silica sand. Sand containing 90 to 95 percent silica is necessary for making steel castings. However, for low melting point metals, such as brass, a high silica percentage is not necessary. Some moulding sands contain a natural bonding agent, and some must have a bonding agent added.

Filter Sands

Filter sands must be fairly uniform and conform to certain screen analyses. They must be free from clay and organic matter, and have a low lime and magnesia content.

Construction

The uses of quartz in construction are manifold, and include quartzite building stones, concrete sand, mortar sand, plaster sand, sand for asphalt pavement, grouting sand, brick sand, and numerous other applications.

Manufactured chemical compounds utilizing quartz include silicon carbide and sodium silicate (waterglass). These substances are made from crushed quartz or silica sand that must contain at least 99 percent silica (SiO_2), and be low in iron content. Silicon carbide is the most important artificial abrasive, and sodium silicate is an important industrial chemical.

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DIVISION OF MINES PUBLICATIONS

The CALIFORNIA JOURNAL OF MINES AND GEOLOGY for OCTOBER 1949, CENTENNIAL EDITION, is now ready for distribution. This issue covers a wide field of interest: it contains articles on the geology of two limestone deposits, one near Sonora, Tuolumne County, the other near Gazelle, Siskiyou County, by G.R. Heyl, J.H. Wiese, and G.W. Walker of the U.S. Geological Survey; the first annual supplement to Bulletin 136, Minerals of California, by J. Murdoch of the University of California at Los Angeles; the concluding chapter (Part 3) of an article on water-flooding as a method of increasing California oil production, by W.H. Somerton of the Division of Mineral Technology, University of California; a paper by E.C. Zimmerman of the Firestone Tire and Rubber Co., on materials of inorganic mineral origin used in the rubber industry; the index to volume 45 of the Journal; and a Centennial Supplement, The Elephant As They Saw It (a collection of contemporary pictures and statements on gold mining in California), by E.L. Egenhoff of the Division of Mines.

THE ELEPHANT AS THEY SAW IT is a 95-page book bound into the October Journal; it traces in quotation and picture gold mining in California, from the first rumor of the "golden island" in the early 16th century to the year 1860, when "The Elephant" was in his prime. It is illustrated with some 70 reproductions of daguerreotypes, ambrotypes, and lithographs of early-day mining scenes, and a colored frontispiece. Some of the mining methods pictured and described are still in use today.

In the current Journal, the series of papers by W.H. Somerton on WATER-FLOODING AS A METHOD OF INCREASING CALIFORNIA OIL PRODUCTION is brought to a close with Part 3, Current and Proposed Water-Flooding Research in California. Part 1, Factors Influencing the Application of Water-Flooding, was released in the April 1949 Journal. Part 2, A Survey of California Conditions Relative to the Application of Water-Flooding, was released in the July 1949 Journal. Two other publications of interest to petroleum producers, engineers, and geologists have also recently been issued. One, BULLETIN 118, GEOLOGIC FORMATIONS AND ECONOMIC DEVELOPMENT OF THE OIL AND GAS FIELDS OF CALIFORNIA (1943), which covers development of the industry, geology of California, occurrence of oil and gas, descriptions of individual oil and gas fields, glossary of geologic formation names, bibliography, index, and map of California (scale 1:1,000,000) showing oil and gas fields and wildcat wells on geologic base, has just been reprinted and is again available. The other, THE BASEMENT COMPLEX IN WELL SAMPLES FROM THE SACRAMENTO AND SAN JOAQUIN VALLEYS, CALIFORNIA, was published in the April 1948 Journal.

MINERALS OF CALIFORNIA has been one of the Division's best-sellers. It has already gone through several editions, under different bulletin numbers; the current edition is BULLETIN 136. Those persons who make a business or hobby of mineral collecting find it especially valuable. Bulletin 136 was released in 1948. Supplement No. 1 (the first of a series of annual supplements), available in the October 1949 Journal, lists descriptions of minerals and mineral occurrences brought to light since the publication of Bulletin 136.

The reports on the GAZELLE and SONORA LIMESTONE DEPOSITS in the October Journal introduce a series of detailed geological investigations of California limestone undertaken by the U.S. Geological Survey, in cooperation with the Division of Mines. They supplement the paper LIMESTONE IN CALIFORNIA published in the July 1947 Journal, in which limestone deposits of the state were briefly described. The vast increase in importance of the nonmetallic mineral industry in recent years has indicated a real need for a detailed geological study. A paper on the INDUSTRIAL USES OF LIMESTONE AND DOLOMITE has also been published, in the April 1949 Journal.

The Division of Mines now has in progress a mineral-commodity study designed to assist the producer of mineral materials to find a market for his products, and also to help the user of mineral materials to find the nearest and most inexpensive source of supply. The October 1949 Journal carries this program one step forward with the paper MATERIALS OF INORGANIC MINERAL ORIGIN USED IN THE RUBBER INDUSTRY.

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MINERAL INFORMATION SERVICE

Vol. 3 January 1, 1950 No. 1

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

MINING AND INDUSTRIAL NEWS NOTES

Rare-Earth Deposit Found in California

An important discovery of rare-earth minerals in an extremely unusual geological formation has been uncovered in southeastern California. The deposit lies near Mountain Pass Service Station on Route 91 in San Bernardino County, 53 miles southwest of Las Vegas, Nevada, and 33 miles northeast of Baker, California. The discovery was made in April 1949, by two of the owners, Clarence Watkins and Herbert S. Woodward of Goodsprings, Nevada.

The unusual nature of the deposit was recognized when the minerals were found to be radioactive by test with the Geiger counter. A preliminary geologic examination has been made by D. Foster Hewett of the U.S. Geological Survey who states that within an area of about 600 by 1,500 feet underlain by Archean rocks, there are at least five veins, three of which contain considerable bastnasite, a fluocarbonate of cerium and lanthanum, with thorium and uranium. The uranium and thorium content, however, appears to be too small to make the deposit of commercial interest for the recovery of these two elements.

In a shallow shaft, the largest vein is about 15 feet wide and it contains between 20 and 30 percent bastnasite. Other rare-earth minerals are present. Accessory minerals are limonite, hematite, barite, fluorite, siderite, quartz, and a little galena. Bastnasite is commonly found in small quantities in some pegmatites; the deposit near Mountain Pass is several lodes in which the most abundant mineral is bastnasite.

Mr. Hewett states that "there can be no doubt that the lodes of the area are a potential commercial source of cerium and lanthanum, the present supply of which is derived from monazite, a mineral largely imported".

Imperial County Pumice Operation

Approximately 500 cars of pumice have been shipped by the Superlite Corporation from their Obsidian Butte deposit located 7½ airline miles northwest of Calipatria. All production to date has been transported to Phoenix, Arizona, but present construction of a pumice-block plant at Calipatria by the same organization will soon allow utilization of the material for the Imperial Valley building industry.

Modern and efficient mining and plant equipment, in use at the quarry, includes a 3/4-yard shovel, 10-yard carryall, bulldozers, jaw and roll crushers and vibrating screens. Products include 1/8- to 3/4-inch screened pumice aggregate. Large boulders up to 2 feet in diameter are shipped to Phoenix for processing into abrasive products. Plant capacity is 50 tons per hour. Operations are under the supervision of Morris Butterfield, P.O. Box 758, Calipatria.

Placer County Gravel Operations

Gold was produced at the Rio Del Oro lode claim a mile and a half southeast of Forest Hill in Placer County during the past summer. Gold occurs in gangue material composed principally of magnesite and is found along a contact of serpentine which strikes north. Although this contact locality has been noted in the past for producing numerous groups of specimen gold ore, the present operators have so far been producing ore of moderate grade. Some small shipments to a smelter have been made. C.W. Doherty and Edward Morrice, Jr., were the operators.

Sand and gravel is being produced on Bear River on the You Bet-Red Dog road one mile from Highway 40 and four miles north of Colfax. A dragline digs gravel from the river bed and all sizes of gravel and crushed rock are produced for concrete work, principally upon the nearby state highway, where extensive improvements are being made a few miles to the south. This gravel is principally tailings from hydraulic mines formerly worked farther upstream for gold. Long regarded as "waste" and as a nuisance, it probably yields a greater profit per cubic yard than was realized by the gold miners who first worked it. Marshall and Miles Gravel Company is the operator.

Gravel at the site of the old mining camp of Virginia on the Takamoto Ranch a few miles west of Newcastle, Placer County, has been worked recently for gold. A Judson-Pacific dry-land placer outfit, handling from 500 to 600 yards daily, is operated by Swartz & Mitchell.

Trinity County Gold Placer

An access road is being built to the old French Bar gravel deposit on the Trinity River a mile and a half east of Del Loma. The Ora Del Loma Company was formed by B.T. Wilke and associates to work this deposit for gold with a slack-line cableway. A portion of the old river bed at this location was mined with a power shovel and trucks in 1941 and the gravel was hauled to a washing plant. Bedrock was over 30 feet deep and costs were high. The new operators have a 3 cubic yard bucket which will travel on a wire cable 2 inches in diameter over a span of 700 feet. M.L. Benoist of Weaverville is supervising the road building and the installation of equipment.

Jade amd Chrysoprase in Tulare County

Nephrite jade of medium to dark-green color, excellent translucency, and fine cutting quality is being mined on leased private land near Porterville, Tulare County. Two separate lenses have been found and more than a ton of material has been mined from one lens. Several more tons are in sight. Compressed-air drilling equipment is used but drilling the exceedingly tough and hard jade has been difficult and slow.

The jade lenses occur on Lewis Hill about two miles north of Porterville. The one now opened up on the southeast flank of the hill appears to be a metamorphosed inclusion in a serpentine sill. Adjoining the sill are vertical beds of metamorphosed sediments and volcanics probably a part of the Kaweah series (Triassic (?)). Of the many rock types seen on the hill most are microcrystalline and difficult to identify. Quartzite (perhaps meta-chert), argillite, and calc-silicate rocks are present in some outcrops.

Only two other nephrite jade localities of possible commercial value are known in the United States, one on the southern coast of Monterey County, California, and one near Lander, Wyoming. A report on the geology and mineralogy of the remarkably well exposed Monterey occurrence is in preparation by a member of the staff of the Division of Mines.

The operators of the jade mine, Frank Janolco and F.V. Alston of Porterville also operate a chrysoprase (a green variety of chalcedony) mine at the old Deer Creek locality south of Porterville. The operators state that this property produced $3,000,000 worth of chrysoprase in the early part of the century when the gem was most popular.

The shallow-workings are in two adjacent fissures in altered volcanic rock. Gem quality chrysoprase makes up part of the hydrothermal filling of the fissures, and very fine material is now being recovered by deeper mining of the shallow-workings driven in the early 1900's. The chrysoprase is marketed to jewelry firms and mineral dealers.

Recent Oil Field Activities

Two of the most active of the new oil discoveries in California are the Guijarral Hills field of Fresno County and the Southern Cuyama field in Cuyama Valley in Santa Barbara County.

Guijarral Hills field was discovered by Barnsdall Oil Company in September 1948. Their well Fred Smith 88 flowed 480 barrels a day of 37.8° gravity oil from the Leda sand of Oligocene age, total depth 8733 feet. A second pool, called the Allison, was discovered by Barnsdall in April 1949. Their well number 73 has an initial flow of 250 barrels a day of 38.2° gravity oil, total depth 8671. The Allison pool is producing from the Temblor formation of Miocene age. By January 1, 1949, five flowing wells had been completed and were in production. Production in the Guijarral Hills field is now (that is, October 1949) running about 11,500 barrels a day from 37 wells, including production from the two sands, the Leda and Allison.

South Cuyama was discovered by Richfield Oil Corporation's Homan A81-35, completed in May 1949. Initial production was at the rate of 1430 barrels a day. South Cuyama production is believed to be of middle Miocene age. Total depth of the discovery well was 4392 feet.

In late October 1949, the most interesting well being drilled in the South Cuyama area is Bell Petroleum Company's Elliot 81-34 located about one mile from Richfield's discovery well. No information is available on this well, but it is being very closely watched by operators because of the fact that its success would increase the width of the Cuyama field to nearly two miles.

These two fields, Guijarral Hills and South Cuyama, along with Placerita in northwest Los Angeles County and Russell Ranch in Cuyama Valley, continue as the most active of the important discoveries of 1948-1949.

Plumas County

In June 1949, the U.S. Bureau of Mines, made a detailed examination of the Sunset manganese property near Greenville. As a result of cleaning out old pits and open cuts, trenching, and drilling and blasting to expose fresh faces for sampling, Bureau engineers proved the existance of a number of large bodies of low-grade manganese ore. Based on these findings, the Utah Construction Company, San Francisco, leased the property and during October moved in heavy mining equipment comprising a power shovel, power digger, bulldozers, portable compressors, rock drills, and dump trucks. To November 25, three carloads of manganese ore have been mined and shipped to the U.S. Steel Company, at Geneva, Utah.

THE COUNTIES OF CALIFORNIA

The mineral resources and mineral production of California's fifty-eight counties are now available in a single volume, Bulletin 142, of the State Division of Mines. This publication is arranged alphabetically by counties and contains, in addition to the production figures, a resumé of the geology of each county, and of the active and idle mineral deposits within those counties. A directory of mineral producers, a list of dealers, custom mills, and commercial grinding plants, and lists of mineral buyers and testing laboratories are included in the volume. Inasmuch as the county statistical data are now available under one cover, publication of data on individual counties will be discontinued in Mineral Information Service.

NEW REPORT ON NEW ALMADEN QUICKSILVER DISTRICT

A report on the New Almaden quicksilver mine, Santa Clara County, California, has been placed in open file for the public inspection. The report, which comprises two index maps, 20 large-scale geologic maps, and a brief explanatory text by E. H. Bailey and D. L. Everhart, may be examined at the U. S. Geological Survey, Room 1033 (Library), General Services Building, Washington, D. C.; Room 102, Old Mint Building, Fifth and Mission Streets, San Francisco, California, and in the office of the California Division of Mines and Geology, Ferry Building, San Francisco, California.

CALIFORNIA MINES USE MILL TAILINGS FOR FILLING

The New Brunswick mine at Grass Valley and the Central Eureka mine at Sutter Creek have recently developed a method of using tailings from the mill for underground filling. The process involves flushing the tailings at high pulp density into the sealed stopes of the mine and draining the excess water. This manner of filling, although not widely used in the past, in not new; however, the batch method which provides absolute control of the pulp density is a unique modification at the local mines. The excellent support provided and the economy of "sand filling," as this system may be called for convenience, have been important factors in the successful operation of these mines during the postwar period of adverse gold economics.

General principles of the system are similar at both properties, but variations of the mining method and especially the physical character of the tailings govern details of best practice in each instance. Preparation of the pulp is an important step and is accomplished in an agitator tank, wherein the measured amounts of tailings and water are mixed by means of an impeller assisted by air jets. The agitator also controls the slimes. It is not desirable to entirely deslime the material, however, because a certain amount of fines improves the character of the fill and facilitates transport of the pulp. Flow of the pulp through the pipeline is preceded and followed by clear water to insure that there will be no blocks in the line due to settled sands. Sealing the stopes in preparation for the fill is not difficult. Bulkheads, for which light timber is adequate, are constructed where necessary, and floors are laid if required. Burlap, newspaper, or excelsior is used for calking around the floors, chutes, and bulkheads, and if necessary against cracks in the wall rock. Drainage of the fill at the New Brunswick is through a perforated closed launder wrapped in burlap, locally called a "mousetrap". At the Central Eureka a flocculant is introduced in the agitator which permits decanting of clear water from a pool formed on top of the fill as it is deposited. Blasting down on the fill is often possible the same day it is placed, and slushers are regularly used for scraping ore over the sand without laying floors. Careful mining allows recovery of pillars directly against the sand which will stand in a vertical face. Both mines have been able to substitute cut-and-fill stoping, in which flexibility of the sand system is fully utilized, for square-set stoping formerly employed.

During first use of the sand system inexperience in sealing the stopes and lack of knowledge regarding pulp densities caused some trouble, but sanding is now routine with rare delays.

The Central Eureka operation where the filling is placed 3600 feet vertically below the agitator tank, demonstrates the feasibility of using hydraulic filling in deep mines. No excessive pressures have resulted nor is there any serious pumping problem. Actually, little water must be returned to the surface since the pulp is sent underground at densities up to 70 percent solids, and an estimated 15 percent moisture is retained in the fill. Another interesting feature at both mines is the use of ordinary compressed air pipe for handling the pulp, disproving a widespread belief that rubber-lined pipe is necessary. A minimum velocity of the pulp and its high slime content are considered to be important factors in reducing abrasion.

Greatest economies of hydraulic sand filling are obtained in manpower and timber, although savings in development work, tailings disposal, and lesser items are realized. The actual filling is done with only two or three men where as many as fifty were formerly required to break, transport, and distribute waste. Bulkheading and preparation of the stopes may require an additional two men or may be done by the "sand men". The sand fill compacts well when it is placed and compresses only slightly upon taking weight, thus permitting the use of much lighter timber than before and substantially reducing the quantity used. Both mines have found that sand filling facilitates rapid mining and enables them to recover a maximum of the ore.

The New Brunswick practice has been described in the January 1949 issue of Engineering and Mining Journal.

CAN YOU HELP US?

The library of the California Division of Mines is anxious to complete the files of many of its serials. Most of the volumes missing from our shelves are out-of-print books which can no longer be purchased on the open market and may be obtained only from personal libraries. We wish to maintain as complete a technical library for public use as possible; consequently, we are asking our readers for donations of periodicals and books on mining and geology. Among those for which we have greatest need are:

American Association of Petroleum Geologists, Bulletin, especially volumes 3, 4, 5, 6, 8, 10, and 11
American Ceramic Society, Journal, all volumes before 1941
American Ceramic Society, Bulletin, all volumes febore 1941
American Institute of Mining and Metallurgical Engineers, Transcations, volumes 113-168
American Institute of Mining and Metallurgical Engineers, Metals Technology, January 1947.
American Institute of Mining and Metallurgical Engineers, Petroleum Technology, volumes 1-11
American Journal of Science, 1st series, volumes 1-50
  2nd series, volumes 1-36
  3rd series, volumes 27-33, 42-50
  4th series, all volumes
  5th series, volumes 1-17
Engineering and Mining Journal, volumes 1-13 (volumes 1-7 were known as American Journal of Mining)
Geological Society of America, Bulletin, volumes 9, 12-24, 29, 36
Journal of Geology, volumes 11-16, 19, 22
Mining and Scientific Press, volumes 1-7
Mining World (San Francisco), 1939
Pacific Science Congress, Proceedings, all, especially 6th, 1940
Pit and Quarry, 1936-1943
Rock Products, 1941-1944
U.S. Geological Survey, Bulletins, early volumes
U.S. Bureau of Mines, Bulletins, Information Circulars, Reports of Investigations, Technical Papers, early issues

A special bookplate showing the donor's name will be placed in each book donated to the library; in addition, certain publications of the Division of Mines, including Bulletins and maps, may be exchanged for "wanted" volumes, or complimentary subscriptions to the California Journal of Mines and Geology may be obtained. If serials are available only for sale, please give prices as quoted to public libraries.

The above list does not represent all of the journals, magazines, and technical publications that the library desires; only those most urgently needed for our public reference service are listed. We would also appreciate textbooks and monographs on mining and geology, for example:

Bowen, N.A., The evolution of igneous rocks, Princeton University Press, 1929
Lilley, E.R., Economic geology of mineral deposits, Henry Holt and Company, 1936
Copper Handbook, volume 1
Mines Handbook, volumes 12, 13, and 16

Anyone willing to donate or exchange with the library is urged to address:

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San Francisco 11, California

MINERAL NEEDS AND PROBLEMS OF THE PETROLEUM INDUSTRY

By
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From the spudding of an oil well to final product refining operations, the petroleum industry utilizes a variety of minerals in addition to the crude oil itself. The aim of this article is to give an idea of the relative importance of the petroleum industry as a consumer of inorganic minerals.

Substantial quantities of various bentonitic clays and barite are consumed in the drilling of oil wells. A good rotary drilling fluid, or "mud", must lubricate and cool the bit, as well as carry away the cuttings at reasonable pumping rates. The mud must be readily pumped, but must also be thixotropic, so that the cuttings will remain suspended when circulation through the well is interrupted. The colloidal properties of the mud must be such that a minimum of water is lost into sands traversed by the drill. The cake sheath which forms on the well must be tough and thin so as to retain formation fluids. Bentonite and clays containing a substantial portion of bentonite have proved satisfactory to meet these qualifications.

A high mud density is necessary to hold gas in high pressure strata. Barite is the material most commonly used for this purpose. Other minerals which have been used less extensively and less satisfactorily are pyrite and hematite.

Small amounts of mica have been employed to aid in preventing loss of drilling fluid into highly permeable formations. Perlite has been tried recently for this purpose and may be expected to come into more widespread use.

Clays are also used extensively in the refining of petroleum, both in the finishing of lubricating oil stocks and, more recently, as a catalyst in the cracking of oils for gasoline manufacture. Development of the various catalytic cracking processes was accelerated during the war because they provided the only practical means for preparing high quality aviation gasoline base stock. Some other minerals used directly in petroleum refining, although to a relatively minor extent, are sulfur, rock salt, bauxite, and diatomaceous earth. Chemicals which are not themselves minerals, strictly speaking, but which are closely related to minerals are used in important quantities in petroleum refining, and thus are mentioned here. Among these are sulfuric acid, caustic soda, tetraethyl lead, litharge, hydrofluoric acid, and lime.

In addition to materials consumed in the actual processing of petroleum, small amounts of graphite, mica, slate, asbestos, and similar materials are incorporated into special greases and roofing materials. There is also a demand for refractories and insulating materials, including vermiculite, fire clay, asbestos, and the magnesium oxide minerals (magnesite, dolomite, etc.), which is unusually high in petroleum refineries due to the widespread application of heat in distillation and cracking operations.

The information that follows is classified according to the particular original mineral involved. The statistical data are primarily from the Minerals Yearbook for 1946, published by the U.S. Bureau of Mines. As mentioned above, some important chemicals that are closely related to native minerals are also included in this compilation.

CLAYS

In both drilling and refining operations the bentonitic, or high-montmorillonite clays are found to be of greatest value. In 1946, well over 200,000 short tons of bentonite, comprising almost 40% of the total domestic consumption of this mineral, were employed in the compounding of rotary drilling muds. Another 25% of the domestic consumption of bentonite, or almost 150,000 tons, was employed in refining operations.

California's production of bentonite, it may be remarked, is small, amounting to less than 3% of the total U. S. production - the major portion of which is found in Wyoming and South Dakota.

Other principally unclassified clays, in which bentonite is an important component, are used for drilling muds in tonnages probably greater than that of bentonite itself, making oil well drilling certainly a major consumer of clay minerals.

In the field of petroleum refining clay minerals are used in several ways. Clay treating is widely utilized for decolorizing lubricating oils, because of the capacity of certain clays to adsorb selectively the highly colored constituents. Chemical processing of some clays has been found to increase markedly their decolorizing capacities, and such products have displaced natural clays to an appreciable extent. The use of bentonite for the decolorizing of oils, amounting to nearly 150,000 tons in 1946, has been mentioned above. Approximately 200,000 tons of fullers earth, or 70% of the total domestic production, are used for decolorizing petroleum products. The clays employed to decolorize lubricating oils may be in the form of, say, 30-60 mesh granules, for the percolation type of operation; or as a finely divided powder to be mixed directly with the oil, from which it is subsequently filtered. The latter operation is customarily employed when the clay is used to neutralize residual acid in the oil.

The marked development of the catalytic cracking of petroleum during the war years has brought about a rather sudden and very large expansion in the demand for montmorillonite clays, which possess the required catalytic activity. It may be of interest that sodium and iron, in more than trace quantities, are considered undesirable constituents of cracking catalysts. Depending on the process employed, the clay may be utilized either as a fine powder or in pelleted form. In either case, resistance to attrition is of considerable importance.

In general it may be stated that the suitability of a clay for any refining use should be determined by testing in the operation for which the clay is proposed; for example, decolorizing capacity, or catalytic activity. Some success has been achieved in correlating fundamental physical and chemical properties of clays with their value in these various applications, but with an entirely new clay, the quickest and surest evaluation will be through the established empirical testing procedures.

BARITE

Since 1938, oil well drilling has been the major consumer of barite, which is used to prevent blowouts, as discussed above. In 1946, 370,000 tons out of a total domestic consumption of 720,000 tons was employed in drilling muds.

BAUXITE

Along with the development of catalytic cracking, the war brought about widespread application of a new alkylation process, involving the use of hydrofluoric acid as a catalyst. To neutralize alkyl fluorides formed through side reactions in this process, the products are passed through a bauxite tower. For this application it is important that the bauxite be very low in silica, as silica and hydrofluoric acid form a volatile compound. The usage of bauxite in this process has been estimated at about 10,000 tons annually. There are other uses for bauxite in petroleum refining, in connection with desulfurization and dehydration, which do not require the low silica property. However, the total bauxite usage in the petroleum industry is well under 2% of the overall domestic consumption of this mineral.

SULFUR

Although a small amount of crystalline sulfur is used in the treating of petroleum products, the only significant consumption of sulfur attributable to the petroleum industry is in the form of sulfuric acid. Approximately one million tons of sulfuric acid per year, or well over 10% of the total consumed in the country, are used in petroleum refining. Sulfuric acid, in turn, accounts for 75% of all of the sulfur consumed.

Production of sulfur, or sulfuric acid, from petroleum sources is becoming increasingly important, especially in the Los Angeles basin area. The refining industry in this state probably produces, as hydrogen sulfide alone, more than enough sulfur to make up its total requirement of sulfuric acid. Plants are now in operation, or are being built, to recover much of this hydrogen sulfide.

FLUORSPAR

The demand for fluorspar of purity suitable for hydrofluoric acid manufacture has been increased appreciably during the war by the development of the HF alkylation process mentioned above. The catalyst usage in this new process has been estimated at approximately 7% of the 280,000-ton annual domestic consumption of fluorspar.

LEAD

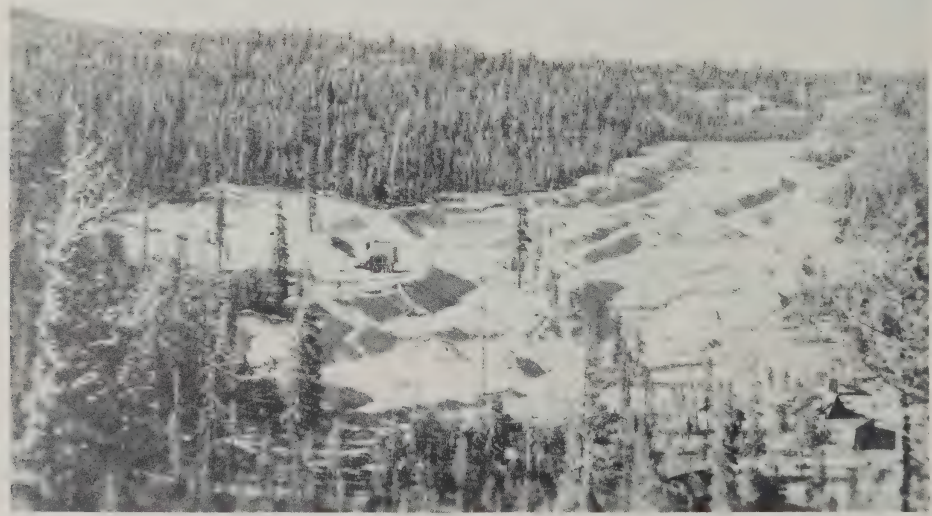
Again departing from the consideration of native minerals, the consumption of manufactured lead compounds in the petroleum industry may be of interest. Treating of gasoline to remove certain odoriferous compounds consumes over 6,000 tons per year of litharge (in caustic solution), or approximately 5% of the total domestic litharge usage. The manufacture of tetraethyl lead accounts for approximately 50,000 tons per year of lead, or almost 10% of the total consumption of refined lead.

SALT

The consumption of rock salt directly in petroleum refining is not important, the chief use being in connection with zeolite water treating. However, it may be mentioned that the use of sodium hydroxide, which is manufactured, ultimately, from salt, comprises one of the major chemical expenses in an oil refinery.

LIME

Approximately 50,000 tons per year of lime, quick or hydrated, is used in petroleum refining, as an acid-neutralizing agent. Compared to the total consumption, the usage in the petroleum industry is less than one percent. In most of the petroleum refining applications, lime is directly competitive with caustic soda. The cost of lime is lower than the cost of an equivalent quantity of caustic, but the greater convenience of handling liquid caustic compensates for this in some cases.



Fouch-Thompson pumice pit. Glass Mountain, eastern Siskiyou County.

CALIFORNIA TOPOGRAPHIC MAPS

The office of the State Engineer, in charge of the State Mapping Program, announces that the following topographic maps of California areas have become available:

PUBLISHED FOR GENERAL DISTRIBUTION

Copies may be secured from local distributing agencies or from the Geological Survey, Denver Federal Center, Denver 15, Colorado, at a cost of 20 cents each.

Reprints with Corrections

Location of S.E. Corner Latitude Deg.	Min.	Longitude Deg.	Min.	Name	Scale	Contour Interval in feet
34	24	117	42	Mescal Creek	1:24,000	5-25
34	24	117	48	Valyermo	1:24,000	5-25
34	24	118	12	Ravenna	1:24,000	5-25
34	30	117	54	Little Rock	1:24,000	5-25
34	36	117	48	Lovejoy Springs	1:24,000	5
34	42	117	48	Joshua	1:24,000	5
34	42	118	00	Roosevelt School	1:24,000	5
34	42	118	00	Oban	1:24,000	5

New Mapping

Location of S.E. Corner Latitude Deg.	Min.	Longitude Deg.	Min.	Name	Scale	Contour Interval in feet
33	00	117	00	Escondido	1:24,000	20
33	00	117	07½	Rancho Santa Fe	1:24,000	20
33	07½	117	07½	San Marcos	1:24,000	20
33	07½	117	15	San Luis Rey	1:24,000	20
33	15	117	07½	Bonsall	1:24,000	20
33	22½	117	30	San Clemente	1:24,000	20
33	30	117	30	Canada Gobernadora	1:24,000	20
33	30	117	45	Laguna Beach	1:24,000	20
37	30	122	22½	Montara Mt.	1:24,000	25
37	52½	122	07½	Briones Valley	1:24,000	25
37	52½	120	00	Duckwall Mt.	1:24,000	50
37	52½	120	07½	Tuolumne	1:24,000	50
37	52½	120	15	Standard	1:24,000	50
37	52½	120	22½	Sonora	1:24,000	50
38	15	120	37½	Mokelumne Hill	1:24,000	40
38	30	121	22½	Sacramento East	1:24,000	5
38	30	121	30	Sacramento West	1:24,000	5
39	30	121	30	Oroville	1:24,000	25
39	37½	121	30	Cherokee	1:24,000	25

Reprints of AMS Maps by USGS

Location of S.E. Corner Latitude Deg.	Min.	Longitude Deg.	Min.	Name	Scale	Contour Interval in feet
33	00	116	45	Ramona	1:62,500	100

PHOTO COMPOSITES

Advance black line ozalid prints of completed maps prepared for final checking and editing. Copies may be secured at a cost of 40 cents each from the Pacific Region Engineer, U.S. Geological Survey, Sacramento 2, California.

Latitude Deg.	Min.	Longitude Deg.	Min.	Name	Scale	Contour Interval in feet
33	15	116	52½	Boucher Hill	1:24,000	20
33	22½	117	07½	Temecula	1:24,000	20
33	37½	117	45	Tustin	1:24,000	5-10
34	00	118	52½	Triunfo Pass	1:24,000	25
36	22½	119	22½	Traver	1:24,000	5
37	37½	122	00	Hayward	1:24,000	25
37	37½	122	22½	San Francisco South	1:24,000	25
37	45	122	22½	San Francisco North	1:24,000	25
38	00	120	15	Columbia S.E.	1:24,000	40
38	30	121	15	Carmichael	1:24,000	5
39	15	121	00	Nevada City	1:24,000	25
39	30	121	22½	Bidwell Bar	1:24,000	25
39	30	121	45	Nelson	1:24,000	5
39	30	121	52½	Llano Seco	1:24,000	5
39	37½	121	45	Chico	1:24,000	5

QUANTITY AND VALUE OF MINERAL SUBSTANCES PRODUCED IN CALIFORNIA DURING 1946, 1947, AND 1948

The following figures for all three years, 1946, 1947, and 1948 are supplied by the United States Bureau of Mines, with which the California State Division of Mines has a cooperative agreement for the collection of these statistics, starting with the year 1947.

Mineral Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore (concentrates)——short tons-	———	———	———	———	5	$1,467
Arsenious oxide——do——	(1)	(1)	(1)	(1)	(1)	(1)
Asbestos——do——	(2)	(2)	(2)	(2)	(2)	(2)
Asphalt (native)——do——	(2)	(2)	(2)	(2)	———	———
Barite——do——	(2)	(2)	(2)	(2)	(2)	(2)
Boron minerals——do——	430,689	$9,575,866	501,935	$11,844,108	450,932	$11,147,735
Bromine——pounds-	(2)	(2)	(2)	(2)	(2)	(2)
Calcite (Iceland spar)——do——	(3)	(3)	(3)	(3)	(3)	(3)
Calcium chloride——short tons-	9,979	170,994	7,968	111,950	10,009	167,610
Cement——barrels-	20,173,231	33,906,675	22,846,458	46,539,749	24,162,926	57,742,226
Chromite——short tons-	(2)	(2)	948	(2)	274	(2)
Clay:						
Products, heavy clay (other than pottery and refractories)——	———	4/12,175,000	———	4/16,793,000	———	4/21,600,000
Raw——short tons-	5/1,670,305	5/2,254,164	5/1,950,076	5/2,965,360	5/2,673,877	5/3,813,329
Coke——do——	260,470	(2 6)	332,244	(2 6)	296,749	(2 6)
Copper——pounds-	8,480,000	1,373,760	4,814,000	1,010,940	962,000	208,754
Diatomite——short tons-	(2)	(2)	(2)	(2)	(2)	(2)
Feldspar (crude)——long tons-	———	———	(2)	(2)	(2)	(2)
Ferro-alloys——short tons-	7,414	(2 6)	5,278	(2 6)	(2 6)	(2 6)
Fuller's earth——do——	(2)	(2)	(2)	(2)	(2)	(2)
Gem stones——	———	(3)	———	(3)	———	(3)
Gold——troy ounces-	356,824	12,488,840	431,415	15,099,525	421,473	14,751,555
Gypsum (crude)——short tons-	574,345	1,315,699	811,798	1,996,157	962,038	2,354,390
Iodine——pounds-	(2)	(2)	(2)	(2)	(2)	(2)
Iron:						
Ore——long tons-	226,062	(2)	373,574	(2)	345,863	(2)
Pig——short tons-	344,024	(2 6)	453,376	(2 6)	375,113	(2 6)
Kyanite——do——	(2)	(2)	———	———	———	———
Lead——do——	9,923	2,163,214	10,080	2,903,040	9,110	3,261,380
Lime——do——	172,623	2,144,712	181,296	2,615,599	179,257	3,026,941
Lithium minerals——do——	(2)	(2)	(2)	(2)	(2)	(2)
Magnesite——do——	(2)	(2)	(2)	(2)	(2)	(2)
Magnesium——do——	56	21,664	———	———	———	———
Magnesium compounds (from sea water) 7/—— short tons MgO equivalent——	55,953	2,814,979	40,000	2,161,000	38,500	2,549,000
Mercury——flasks (76 pounds)-	17,782	1,746,904	17,165	1,437,397	11,188	855,770
Mica, scrap——short tons-	(2)	(2)	(2)	(2)	———	———
Mineral waters——gallons sold-	(3)	(3)	(3)	(3)	(3)	(3)
Molybdenum——pounds-	(2)	(2)	(2)	(2)	(2)	(2)
Natural gas (estimated value at wells)—— M cubic feet-	487,904,000	36,056,000	560,510,000	57,284,000	570,954,000	64,803,000
Natural gasoline and allied products:						
Natural gasoline and cycle products gallons-	734,227,000	32,085,000	833,473,000	46,302,000	842,425,000	69,578,000

Liquefied petroleum gases------gallons-	176,311,000	4,933,000	230,635,000	7,901,000	269,644,000	16,961,000
Ores (crude), etc.:						
Copper---------------------short tons-	86,297	(8)	15,993	(8)	152	(8)
Dry and siliceous (gold and silver)-do-	335,657	(8)	449,792	(8)	424,227	(8)
Lead----------------------short tons-	57,330	(8)	87,913	(8)	22,005	(8)
Zinc----------------------------do-----	45,043	(8)	49,651	(8)	5,233	(8)
Zinc-copper---------------------do-----	99,176	(8)	35,745	(8)	-------	-------
Zinc-lead-----------------------do-----	4,264	(8)	9,695	(8)	75,159	(8)
Peat--------------------------------do-----	8,137	105,242	(2)	(2)	6,942	33,265
Pebbles for grinding----------------do-----	74	927	(2)	(2)	(2)	(2)
Perlite-----------------------------do-----	-------	-------	-------	-------	(2)	(2)
Petroleum--------------------------barrels-	314,713,000	387,100,000	333,132,000	572,990,000	340,089,000	823,696,000
Platinum metals (crude)-------troy ounces-	67	(2)	324	(2)	272	(2)
Potassium salts----------------short tons-	(2)	(2)	(2)	(2)	(2)	(2)
Pumice------------------------------do-----	89,181	755,570	169,037	1,026,275	196,934	1,110,447
Pyrites-------------------------long tons-	(2)	(2)	(2)	(2)	(2)	(2)
Quartz-------------------------short tons-	(2)	(2)	(2)	(2)	(2)	(2)
Salt (sodium chloride)--------------do-----	729,092	3,358,060	768,397	3,810,898	914,035	3,927,722
Sand and gravel---------------------do-----	27,220,849	18,396,460	31,386,826	25,338,967	33,786,520	30,592,965
Sand and sandstone (ground)---------do-----	(2)	(2)	(2)	(2)	(2)	(2)
Silver----------------------troy ounces--	1,342,651	1,084,862	1,597,442	1,445,685	724,771	655,954
Slate--------------------------------------	-------	(2)	-------	(2)	-------	(2)
Sodium carbonate---------------short tons-	215,625	3,427,086	293,051	5,862,178	288,769	6,623,280
Sodium sulfate----------------------do-----	(2)	(2)	(2)	(2)	(2)	(2)
Stone-------------------------------do-----	9/8,950,320	9/8,452,083	9/12,757,790	9/13,012,556	9/11,936,240	9/13,155,454
Strontium minerals------------------do-----	243	3,726	-------	-------	-------	-------
Sulfuric acid (basis, 100 percent) 10/---- short tons-	(2 6)	(2 6)	(2 6)	(2 6)	(2 6)	(2 6)
Sulfur ore----------------------long tons-	757	11,835	698	9,074	(2)	(2)
Talc, pyrophyllite, and ground soapstone short tons-	78,170	1,434,978	91,537	1,595,422	98,681	1,773,764
Titanium concentrates: Ilmenite----do-----	-------	-------	-------	-------	(2)	(2)
Tungsten concentrates (60-percent WO_3 basis)-------------------------do-----	1,262	1,117,855	394	548,233	1,767	(2)
Zinc--------------------------------do-----	6,877	1,677,988	5,415	1,310,430	5,325	1,416,450
Miscellaneous 11/-------------------------	-------	21,909,443	-------	29,565,251	-------	41,595,712
Total value, eliminating duplications--	-------	592,294,000	-------	859,039,000	-------	1,174,674,000

1/ Figure not available.

2/ Value included with "Miscellaneous."

3/ No canvass.

4/ Figure obtained through cooperation with Bureau of Census.

5/ Sold or used; value of clay used in cement and heavy clay products is included here but is not included in total value for State.

6/ Value not included in total value for State

7/ Comprises all compounds from raw sea water and bitterns. Data for 1946 are not quite comparable with 1947-48 in that the former are on a gross-weight basis and include some compounds made from dolomite in combination with sea water. Figures for 1947-48 are partly estimated.

8/ Not valued as ore; value of recoverable metal content included with the metals.

9/ Exclusive of marble in 1946-47 and of dimension basalt in 1948, values for which are included with "Miscellaneous."

10/ From lead smelting.

11/ Includes minerals indicated by "2/" and "9/" above.

VALUE OF MINERAL PRODUCTION OF CALIFORNIA IN 1947-48, BY COUNTIES*

County	1947	1948	County	1947	1948
Alameda	$8,467,741	$8,771,793	Riverside	$8,381,215	$9,269,937
Alpine	(1)	(1)	Sacramento	14,341,144	16,737,925
Amador	913,189	941,126	San Benito	2,497,069	2,803,469
Butte	1,312,410	1,284,737	San Bernardino	36,699,909	44,640,646
Calaveras	4,199,321	4,662,145	San Diego	1,882,394	2,594,065
Colusa	89,963	20,756	San Francisco	(3)	(3)
Contra Costa	1,405,682	1,255,576	San Joaquin	2,968,420	3,077,835
Del Norte	322,156	186,902	San Luis Obispo	396,393	1,428,990
El Dorado	1,641,020	1,758,799	San Mateo	5,334,024	5,707,031
Fresno	89,626,207	124,450,502	Santa Barbara	40,676,339	60,753,770
Glenn	2/388,043	2/271,276	Santa Clara	11,978,918	13,317,067
Humboldt	313,364	407,996	Santa Cruz	3,216,500	4,024,125
Imperial	907,843	1,957,508	Shasta	2,271,226	1,680,434
Inyo	6,596,468	10,286,796	Sierra	468,196	384,223
Kern	209,037,916	293,773,122	Siskiyou	1,170,971	1,012,137
Kings	24,750,000	36,337,310	Solano	8,535,751	8,903,771
Lake	107,232	116,787	Sonoma	1,050,051	1,029,437
Lassen	71,828	38,156	Stanislaus	1,113,357	954,234
Los Angeles	203,529,633	278,436,293	Sutter	113,789	130,447
Madera	307,176	446,627	Tehama	(2)	(2)
Marin	461,179	389,245	Trinity	561,555	311,010
Mariposa	333,601	280,739	Tulare	1,527,551	2,057,745
Mendocino	3/528,181	3/426,130	Tuolumne	901,067	850,342
Merced	742,366	869,757	Ventura	62,807,862	87,543,246
Modoc	116,170	145,490	Yolo	261,428	144,870
Mono	332,893	355,497	Yuba	2,559,132	2,226,195
Monterey	2,979,297	4,196,755			
Napa	359,911	303,385	Heavy clay products (not entirely separable by counties) 4/	15,605,828	20,042,303
Nevada	1/3,008,304	1/3,659,073			
Orange	68,115,831	106,472,783			
Placer	487,751	512,671			
Plumas	261,100	32,975	State total (rounded)	859,039,000	1,174,674,000

*These figures are furnished by the United States Bureau of Mines in cooperation with the California State Division of Mines.

1/ Output of Alpine County is included with Nevada County.

2/ Output of Tehama County is included with Glenn County.

3/ Output of San Francisco County is included with Mendocino County.

4/ Figures shown represent value of heavy clay products (other than pottery and refractories) as reported by U.S. Bureau of the Census, less value of raw clay sold or used for the manufacture of cement and heavy clay products, as follows: 1947-$16,793,000 and $1,187,172, respectively; 1948-$21,600,000 and $1,557,697, respectively.

MINERAL PRODUCTION OF CALIFORNIA IN 1947-48, BY COUNTIES*

ALAMEDA COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)	------	1/$1,165,000	-------	1/$1,342,00
Clay raw------short tons	18,751	18,782	14,404	16,10
Salt (sodium chloride)------do	540,943	3,046,907	663,108	3,091,37
Sand and gravel------do	3,844,057	3,578,314	3,896,600	4,026,28
Stone------do	1,112,500	714,025	1,002,200	742,90
Unapportioned (bromine, lime, and magnesium compounds)	------	1,109,713	-------	895,
Total value------	-------	8,467,741	-------	8,771,79

ALPINE COUNTY

Minerals produced in Alpine County were: 1947 - Tungsten concentrates; 1948 - copper, gold, silver, sulfur ore, and tungsten concentrates.

AMADOR COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Clay, raw—short tons	198,264	$380,496	189,884	$625,537
Copper—pounds	1,674,000	351,540	-------	-------
Gold—troy ounces	4,724	165,340	6,614	231,490
Sand and gravel—short tons	(2)	(2)	34,490	65,476
Silver—troy ounces	11,598	10,496	2,252	2,038
Stone—short tons	(2)	(2)	21,270	(2)
Unapportioned (pumicite and items indicated by footnote 2)	-------	5,317	-------	16,585
Total value	-------	913,189	-------	941,126

BUTTE COUNTY

Chromite—short tons	308	(2)	-------	-------
Gold—troy ounces	27,037	$946,295	26,137	$914,795
Sand and gravel—short tons	55,643	57,123	148,990	192,798
Silver—troy ounces	2,201	1,992	1,990	1,801
Stone—short tons	(2)	(2)	224,770	158,895
Unapportioned (natural gas, crude platinum metals, and items indicated by footnote 2)	-------	307,000	-------	16,448
Total value	-------	1,312,410	-------	1,284,737

CALAVERAS COUNTY

Copper—pounds	1,242,000	$260,820	-------	-------
Gold—troy ounces	5,171	180,985	1,196	$41,860
Lead—short tons	90	25,920	1	358
Sand and gravel—do	(2)	(2)	113,871	204,507
Silver—troy ounces	97,076	87,854	640	579
Stone—short tons	(2)	(2)	-------	-------
Zinc—do	2,350	568,700	-------	-------
Unapportioned (cement, raw clay, pumice, and items indicated by footnote 2)	-------	3,075,042	-------	4,414,841
Total value	-------	4,199,321	-------	4,662,145

COLUSA COUNTY

Gold—troy ounces	6	$210	2	$70
Sand and gravel—short tons	225,729	89,750	65,711	20,685
Silver—troy ounces	3	3	1	1
Total value	-------	89,963	-------	20,756

CONTRA COSTA COUNTY

Clay products, heavy clay (other than pottery and refractories)	-------	(3)	-------	(3)
Peat—short tons	-------	-------	(2)	(2)
Sand and gravel—do	378,734	$248,403	372,013	$252,229
Stone—do	472,020	509,546	499,110	586,904
Unapportioned (raw clay, natural gas, pumice, and item indicated by footnote 2)	-------	647,733	-------	416,443
Total value	-------	1,405,682	-------	1,255,576

DEL NORTE COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Chromite—short tons	640	(2)	274	(2)
Mercury—flasks	-------	-------	5	$382
Sand and gravel—short tons	55,017	(2)	(2)	(2)
Unapportioned (stone and items indicated by footnote 2)	-------	$322,156	-------	186,520
Total value	-------	322,156	-------	186,902

EL DORADO COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Copper—pounds	112,000	$23,520	72,000	$15,624
Gold—troy ounces	2,994	104,790	2,592	90,720
Lead—short tons	2	576	-------	-------
Silver—troy ounces	2,039	1,845	1,391	1,259
Stone—short tons	211,780	483,991	176,130	490,086
Zinc—do	6	1,452	-------	-------
Unapportioned (lime, sand and gravel, slate, and soapstone)	-------	1,024,846	-------	1,161,110
Total value	-------	1,641,020	-------	1,758,799

FRESNO COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)	-------	(3)	-------	(3)
Gold—troy ounces	235	$8,225	(2)	(2)
Gypsum, crude—short tons	(2)	(2)	15,443	$23,271
Mercury—flasks	(2)	(2)	-------	-------
Natural gas—M cu. ft.	65,636,000	6,943,000	69,644,000	7,224,000
Natural gasoline and allied products:				
Natural gasoline 4/—gallons	75,488,000	3,990,000	26,623,000	2,199,000
Liquefied petroleum gases 4/—do	41,170,000	1,642,000	22,262,000	1,400,000
Petroleum—barrels	44,137,000	75,560,000	45,841,000	111,920,000
Sand and gravel—short tons	1,031,322	1,141,346	932,804	1,022,024
Silver—troy ounces	37	33	(2)	(2)
Stone—short tons	164,910	292,835	416,530	618,459
Tungsten concentrates (60% WO_3 basis)—do	(2)	(2)	11	15,858
Unapportioned (raw clay and items indicated by footnote 2)	-------	48,768	-------	27,890
Total value	-------	89,626,207	-------	124,450,502

GLENN COUNTY

Production in Glenn County in 1947-48 consisted of natural gas and sand and gravel.

HUMBOLDT COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)	-------	(3)	-------	(3)
Gold—troy ounces	139	$4,865	(2)	(2)
Sand and gravel—short tons	261,063	221,278	359,243	$293,016
Silver—troy ounces	22	20	(2)	(2)
Stone—short tons	60,120	(2)	23,310	(2)
Unapportioned (raw clay, natural gas, and items indicated by footnote 2)	-------	92,201	-------	114,980
Total value	-------	318,364	-------	407,996

IMPERIAL COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Gold---troy ounces	-------	-------	171	$5,985
Mica (scrap)---short tons	(2)	(2)	-------	-------
Sand and gravel---do	232,704	(2)	488,277	(2)
Silver---troy ounces	-------	-------	93	84
Stone---short tons	-------	-------	(2)	(2)
Unapportioned (crude gypsum and items indicated by footnote 2)---	-------	$907,843	-------	1,951,439
Total value---	-------	907,843	-------	1,957,508

INYO COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Antimony ore---short tons	-------	-------	5	$1,467
Copper---pounds	232,000	$48,720	598,000	129,766
Gold---troy ounces	1,974	69,090	1,794	62,790
Lead---short tons	8,990	2,589,120	8,620	3,085,960
Sand and gravel---do	(2)	(2)	105,176	111,937
Silver---troy ounces	1,235,998	1,118,578	573,283	518,850
Slate---	-------	-------	-------	(2)
Stone---short tons	69,320	118,471	(2)	(2)
Sulfur ore---long tons	698	9,074	(2)	(2)
Talc and pyrophyllite---short tons	30,444	482,007	33,546	471,596
Zinc---do	702	169,884	4,660	1,239,560
Unapportioned (boron minerals, raw clay, diatomite, fuller's earth, molybdenum, pumice and pumicite, sodium salts, tungsten concentrates, and items indicated by footnote 2)---	-------	1,991,524	-------	4,664,870
Total value---	-------	6,596,468	-------	10,286,796

KERN COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Clay products, heavy clay (other than pottery and refractories)---	-------	(3)	-------	(3)
Clay, raw---short tons	213,475	$746,372	215,953	$768,280
Feldspar, crude---long tons	-------	-------	(2)	(2)
Gold---troy ounces	6,228	217,980	6,176	216,160
Gypsum, crude---short tons	5/352,977	5/558,269	271,908	414,233
Natural gas---M cu. ft.	88,753,000	8,566,000	84,803,000	8,414,000
Natural gasoline and allied products:				
Natural gasoline---gallons	134,520,000	6,839,000	143,654,000	11,865,000
Liquefied petroleum gases---do	90,458,000	3,452,000	107,801,000	6,781,000
Petroleum---barrels	106,058,000	176,761,000	105,426,000	253,636,000
Sand and gravel---short tons	608,674	671,917	581,495	663,945
Silver---troy ounces	7,686	6,956	13,509	12,226
Stone---short tons	(2)	(2)	-------	-------
Unapportioned (boron minerals, cement, pumice and pumicite, quartz, salt, tungsten concentrates, and items indicated by footnote 2)---	-------	11,218,422	-------	11,002,278
Total value---	-------	209,037,916	-------	293,773,122

KINGS COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Gypsum, crude---short tons	(5)	(5)	(2)	(2)
Natural gas---M cu. ft.	41,113,000	$4,404,000	40,310,000	$4,545,000
Natural gasoline and allied products:				
Natural gasoline 4/---gallons	63,534,000	3,512,000	116,075,000	9,587,000
Liquefied petroleum gases 4/---do	36,525,000	1,317,000	66,480,000	4,182,000
Petroleum---barrels	7,504,000	15,517,000	6,551,000	17,965,000
Sand and gravel---short tons	-------	-------	(2)	(2)
Unapportioned (items indicated by footnote 2)---	-------	-------	-------	58,310
Total value---	-------	24,750,000	-------	36,337,310

LAKE COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Mercury------flasks-	364	(2)	(2)	(2)
Sand and gravel------short tons-	70,284	(2)	125,008	(2)
Stone------do----	(2)	(2)	2,430	(2)
Unapportioned (items indicated by footnote 2)------	-------	$107,232	-------	$116,787
Total value------	-------	107,232	-------	116,787

LASSEN COUNTY

Gold------troy ounces-	1	$35	121	$4,235
Silver------do------	6	5	102	92
Stone------short tons-	42,980	(2)	(2)	(2)
Unapportioned (sand and gravel and items indicated by footnote 2)------	-------	71,788	-------	33,829
Total value------	-------	71,828	-------	38,156

LOS ANGELES COUNTY

Clay products, heavy clay (other than pottery and refractories)------	-------	1/$10,936,000	-------	1/$14,791,000
Clay, raw------short tons-	477,011	436,146	491,167	368,784
Gold------troy ounces-	48	1,680	215	7,525
Lime------short tons-	(2)	(2)	-------	-------
Natural gas------M cu. ft.-	98,435,000	8,586,000	102,783,000	11,588,000
Natural gasoline and allied products:				
Natural gasoline------gallons-	299,343,000	16,098,000	313,871,000	25,923,000
Liquefied petroleum gases------do	16,036,000	491,000	19,982,000	1,257,000
Petroleum------barrels-	91,897,000	164,496,000	91,096,000	223,002,000
Quartz------short tons-	(2)	(2)	-------	-------
Sand and gravel------do------	11,088,519	6,866,923	11,909,517	8,085,435
Silver------troy ounces-	6	5	36	33
Stone------short tons-	4,284,150	3,167,650	4,425,270	4,323,469
Titanium concentrates (ilmenite)---do---	-------	-------	(2)	(2)
Unapportioned (cement, diatomite, iodine, soapstone and items indicated by footnote 2)------	-------	3,386,229	-------	3,881,047
Total value------	-------	203,529,633	-------	278,436,293

MADERA COUNTY

Copper------pounds-	-------	-------	10,000	$2,170
Feldspar------long tons-	(2)	(2)	-------	-------
Gold------troy ounces-	197	$6,895	(2)	(2)
Pumice and pumicite------short tons-	21,730	153,473	8,311	82,719
Sand and gravel------do------	-------	-------	26,399	19,040
Silver------troy ounces-	57	52	(2)	(2)
Stone------short tons-	(2)	(2)	-------	-------
Tungsten concentrates (60% WO_3 basis)-do-	(2)	(2)	58	(2)
Unapportioned (natural gas and items indicated by footnote 2)------	-------	146,756	-------	342,698
Total value------	-------	307,176	-------	446,627

MARIN COUNTY

Production in Marin County in 1947-48 consisted of raw clay, sand and gravel, and stone.

MARIPOSA COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Copper—pounds	4,000	$840	-------	-------
Gold—troy ounces	6,363	222,705	7,525	$263,375
Platinum metals (crude)—do	-------	-------	(2)	(2)
Quartz—short tons	(2)	(2)	-------	-------
Sand and gravel—do	(2)	(2)	17,127	13,331
Silver—troy ounces	1,933	1,749	2,166	1,960
Slate	-------	-------	-------	(2)
Stone—short tons	(2)	(2)	-------	-------
Unapportioned (barite and items indicated by footnote 2)	-------	108,307	-------	2,073
Total value	-------	333,601	-------	280,739

MENDOCINO COUNTY

Production in Mendocino County in 1947-48 consisted of sand and gravel.

MERCED COUNTY

Production in Merced County in 1947-48 consisted of gold, crude platinum metals, sand and gravel, and silver.

MODOC COUNTY

Gold—troy ounces	-------	-------	141	$4,935
Pumice—short tons	(2)	(2)	14,165	79,095
Sand and gravel—do	198,513	(2)	114,018	61,394
Silver—troy ounces	-------	-------	73	66
Stone—short tons	79,180	(2)	-------	-------
Unapportioned (items indicated by footnote 2)	-------	$116,170	-------	-------
Total value	-------	116,170	-------	145,490

MONO COUNTY

Copper—pounds	18,000	$3,780	-------	-------
Gold—troy ounces	41	1,435	63	$2,205
Lead—short tons	17	4,896	2	716
Pumice—do	4,738	220,088	8,582	257,335
Silver—troy ounces	7,323	6,627	788	713
Stone—short tons	(2)	(2)	-------	-------
Tungsten concentrates—do	(2)	(2)	-------	-------
Unapportioned (pyrophyllite, sand and gravel, and items indicated by footnote 2)	-------	96,067	-------	94,528
Total value	-------	332,893	-------	355,497

MONTEREY COUNTY

Gold—troy ounces	-------	-------	24	$840
Sand and gravel—short tons	646,973	$1,022,058	808,160	1,525,600
Silver—troy ounces	-------	-------	6	5
Stone—short tons	147,730	232,980	197,150	281,166
Unapportioned (lime, magnesium compounds, petroleum, salt and ground sand and sandstone)	-------	1,724,259	-------	2,389,144
Total value	-------	2,979,297	-------	4,196,755

NAPA COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Gold--------troy ounces-	-------	-------	2	$70
Perlite, crude--------short tons-	-------	-------	(2)	(2)
Sand and gravel--------do----	(2)	(2)	37,670	32,600
Silver--------troy ounces-	-------	-------	29	26
Stone--------short tons-	161,440	$202,386	58,130	78,512
Unapportioned (mercury, pumice and pumicite and items indicated by footnote 2)	-------	157,525	-------	192,177
Total value--------	-------	359,911	-------	303,385

NEVADA COUNTY

Minerals produced in Nevada County were: 1947-gold, silver, and stone; 1948-gold, sand and gravel, and silver.

ORANGE COUNTY

Clay products, heavy clay (other than pottery and refractories)--------	-------	(3)	-------	(3)
Clay, raw--------short tons-	20,437	$72,520	19,292	$74,984
Natural gas--------M cu. ft.-	30,238,000	2,535,000	30,844,000	3,338,000
Natural gasoline and allied products:				
Natural gasoline--------gallons-	114,894,000	5,974,000	115,378,000	9,529,000
Liquefied petroleum gases--------do----	4,472,000	145,000	9,785,000	615,000
Petroleum--------barrels-	34,149,000	58,407,000	38,217,000	91,929,000
Sand and gravel--------short tons-	961,207	812,831	908,737	813,411
Stone--------do----	(2)	(2)	116,130	(2)
Unapportioned (peat, salt, and items indicated by footnote 2)--------	-------	169,480	-------	173,388
Total value--------	-------	68,115,831	-------	106,472,783

PLACER COUNTY

Clay products, heavy clay (other than pottery and refractories)--------	-------	(3)	-------	(3)
Gold--------troy ounces-	5,358	$187,530	1,330	$46,550
Silver--------do----	807	730	1,503	1,360
Slate--------	-------	(2)	-------	-------
Stone--------short tons-	100,410	81,976	(2)	(2)
Unapportioned (asbestos, raw clay, sand and gravel and items indicated by footnote 2)--------	-------	217,515	-------	464,761
Total value--------	-------	487,751	-------	512,671

PLUMAS COUNTY

Barite--------short tons-	(2)	(2)	-------	-------
Copper--------pounds-	28,000	$5,880	-------	-------
Gold--------troy ounces-	546	19,110	699	$24,465
Sand and gravel--------short tons-	(2)	(2)	18,300	8,450
Silver--------troy ounces-	570	516	66	60
Stone--------short tons-	201,480	(2)	-------	-------
Unapportioned (items indicated by footnote 2)--------	-------	235,594	-------	-------
Total value--------	-------	261,100	-------	32,975

RIVERSIDE COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)	-------	(3)	-------	(3)
Clay, raw—short tons	283,177	(2)	339,996	$562,244
Gold—troy ounces	30	$1,050	4	140
Iron ore—long tons	27,029	(2)	66,617	(2)
Lead—short tons	-------	-------	1	358
Sand and gravel—do	472,839	517,871	802,621	482,844
Silver—troy ounces	15	14	101	91
Stone—short tons	138,250	156,700	7,160	12,562
Unapportioned (cement, crude gypsum, and items indicated by footnote 2)	-------	7,705,580	-------	8,211,698
Total value	-------	8,381,215	-------	9,269,937

SACRAMENTO COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)	-------	1/$340,000	-------	1/$368,000
Clay, raw—short tons	30,619	(2)	23,495	(2)
Gold—troy ounces	113,560	3,974,600	118,152	4,135,320
Natural gas—M cu. ft.	74,964,000	8,595,000	81,791,000	10,874,000
Platinum metals (crude)—troy ounces	(2)	(2)	71	(2)
Sand and gravel—short tons	1,564,464	1,334,108	1,453,173	1,353,347
Silver—troy ounces	6,203	5,614	6,491	5,875
Stone—short tons	269,400	375,438	(2)	(2)
Unapportioned (items indicated by footnote 2)	-------	56,384	-------	369,383
Total value	-------	14,341,144	-------	16,737,925

SAN BENITO COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Mercury—flasks	9,228	$772,753	(2)	(2)
Petroleum—barrels	-------	-------	(2)	(2)
Stone—short tons	1,013,980	(2)	(2)	(2)
Unapportioned (cement, raw clay, sand and gravel, and items indicated by footnote 2)	-------	1,724,316	-------	$2,803,469
Total value	-------	2,497,069	-------	2,803,469

SAN BERNARDINO COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Calcium-magnesium chloride—short tons	7,968.	$111,950	10,009	$167,610
Clay, raw—do	63,491	232,206	165,303	386,355
Coke—do	332,244	(6)	296,749	(6)
Copper—pounds	92,000	19,320	118,000	25,606
Feldspar, crude—long tons	-------	-------	(2)	(2)
Gold—troy ounces	4,409	154,315	1,518	53,130
Iron ore—long tons	346,545	(2)	279,246	(2)
Iron, pig—short tons	453,376	(6)	375,113	(6)
Lead—do	158	45,504	419	150,002
Lime—do	31,457	328,329	27,393	405,411
Pumice—do	-------	-------	(2)	(2)
Salt (sodium chloride)—do	150,293	386,742	(2)	(2)
Sand and gravel—do	1,151,258	1,124,251	1,671,019	1,560,323
Silver—troy ounces	103,877	94,009	57,538	52,075
Stone—short tons	558,580	827,992	1,195,970	1,563,225
Talc—do	46,535	997,446	52,622	1,160,255
Tungsten concentrates (60% WO_3 basis)—do	(2)	(2)	263	(2)
Zinc—do	650	157,300	219	58,254
Unapportioned (boron minerals, bromine, cement, lithium minerals, petroleum, potassium salts, quartz, sodium salts and items indicated by footnote 2)	-------	32,220,545	-------	39,058,400
Total value	-------	36,699,909	-------	44,640,646

SAN DIEGO COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)	—	(3)	—	(3)
Clay, raw—short tons	14,533	$15,005	35,222	$60,922
Gold—troy ounces	13	455	8	280
Sand and gravel—short tons	1,195,011	1,324,830	1,395,701	1,829,989
Silver—troy ounces	6	5	3	3
Stone—short tons	79,410	196,037	91,570	280,626
Unapportioned (magnesium compounds, pebbles for grinding, pyrophyllite, and salt)	—	346,062	—	422,245
Total value	—	1,882,394	—	2,594,065

SAN FRANCISCO COUNTY

Production in San Francisco County was as follows: 1947-heavy clay products, gold, and stone; 1948-heavy clay products and stone.

SAN JOAQUIN COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)	—	1/$291,000	—	1/$274,000
Clay, raw—short tons	(2)	(2)	18,184	14,259
Natural gas—M cu. ft.	9,926,000	1,297,000	8,277,000	1,313,000
Platinum metals (crude)—troy ounces	—	—	(2)	(2)
Sand and gravel—short tons	1,598,607	1,330,544	1,679,808	1,617,023
Unapportioned (gold, silver, stone, and items indicated by footnote 2)	—	340,876	—	133,553
Total value	—	2,968,420	—	3,077,835

SAN LUIS OBISPO COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)	—	(3)	—	(3)
Mercury—flasks	449	$37,599	(2)	(2)
Petroleum—barrels	(2)	(2)	460,000	$1,208,000
Pumicite—short tons	—	—	(2)	(2)
Sand and gravel—do	(2)	(2)	165,064	205,053
Unapportioned (raw clay, stone, and items indicated by footnote 2)	—	358,794	—	15,937
Total value	—	396,393	—	1,428,990

SAN MATEO COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay, raw—short tons	—	—	(2)	(2)
Stone—do	1,078,700	$1,184,602	780,390	$738,085
Unapportioned (cement, magnesium compounds, sand and gravel and item indicated by footnote 2)	—	4,149,422	—	4,968,946
Total value	—	5,334,024	—	5,707,031

SANTA BARBARA COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)	—	(3)	—	(3)
Natural gas—M cu. ft.	18,586,000	$1,355,000	20,329,000	$1,925,000
Natural gasoline and allied products:				
Natural gasoline—gallons	36,059,000	1,881,000	24,987,000	2,064,000
Liquefied petroleum gases—do	1,523,000	51,000	8,419,000	530,000
Petroleum—barrels	22,465,000	33,297,000	23,756,000	51,992,000
Sand and gravel—short tons	198,897	(2)	185,629	(2)
Stone—do	379,890	(2)	301,890	(2)
Unapportioned (raw clay, diatomite, and items indicated by footnote 2)	—	4,092,339	—	4,242,770
Total value	—	40,676,339	—	60,753,770

SANTA CLARA COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay products, heavy clay (other than pottery and refractories)——	———	1/$1,201,000	———	1/$1,271,000
Clay, raw——short tons—	158,206	(2)	177,780	(2)
Ferro-alloys——do——	5,278	(6)	(6)	(6)
Mercury——flasks—	586	49,072	(2)	(2)
Sand and gravel——short tons—	352,266	(2)	457,451	(2)
Stone——do——	400,080	462,732	255,040	189,241
Unapportioned (cement, magnesite, petroleum, and items indicated by footnote 2)	———	11,467,114	———	13,127,826
Total value——	———	11,978,918	———	13,317,067

SANTA CRUZ COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Asphalt——short tons—	(2)	(2)	———	———
Lime——do——	(2)	(2)	———	———
Peat——do——	(2)	(2)	———	———
Stone——do——	27,280	$134,127	(2)	(2)
Unapportioned (cement, raw clay, sand and gravel, and items indicated by footnote 2)——	———	3,082,373	———	$4,024,125
Total value——	———	3,216,500	———	4,024,125

SHASTA COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Copper——pounds—	1,396,000	$293,160	156,000	$33,852
Gold——troy ounces—	(2)	(2)	11,538	403,830
Lead——short tons—	817	235,296	53	18,974
Platinum metals (crude)——troy ounces—	———	———	(2)	(2)
Sand and gravel——short tons—	258,960	224,273	490,722	440,953
Silver——troy ounces—	(2)	(2)	18,935	17,137
Stone——short tons—	(2)	(2)	128,410	(2)
Zinc——do——	1,707	413,094	446	118,636
Unapportioned (asbestos, pyrites, and items indicated by footnote 2)——	———	1,105,403	———	647,052
Total value——	———	2,271,226	———	1,680,434

SIERRA COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Copper——pounds—	———	———	2,000	$434
Gold——troy ounces—	13,263	$464,205	10,430	365,050
Lead——short tons—	6	1,728	14	5,012
Sand and gravel——do——	———	———	33,000	11,550
Silver——troy ounces—	2,501	2,263	2,405	2,177
Total value——	———	468,196	———	384,223

SISKIYOU COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Gold——troy ounces—	(2)	(2)	21,226	$742,910
Platinum metals (crude)——do——	———	———	(2)	(2)
Pumice——short tons—	19,965	$143,963	35,577	173,136
Silver——troy ounces—	(2)	(2)	2,757	2,495
Stone——short tons—	188,970	149,679	177,770	57,642
Unapportioned (diatomite, sand and gravel, and items indicated by footnote 2)——	———	877,329	———	35,954
Total value——	———	1,170,971	———	1,012,137

SOLANO COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Natural gas——M cu. ft.—	67,278,000	$8,388,000	66,212,000	$8,746,000
Unapportioned (sand and gravel and stone)	——	147,751	——	157,771
Total value——	——	8,535,751	——	8,903,771

SONOMA COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Mercury——flasks—	4,247	$355,644	(2)	(2)
Natural gas——M cu. ft.—	——	——	(2)	(2)
Petroleum——barrels—	——	——	(2)	(2)
Pumice——short tons—	(2)	(2)	——	——
Sand and gravel——do——	584,044	515,340	(2)	(2)
Stone——do——	141,370	(2)	135,690	$169,636
Unapportioned (items indicated by footnote 2)——	——	179,067	——	859,801
Total value——	——	1,050,051	——	1,029,437

STANISLAUS COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Pumicite——short tons—	——	——	2,066	$3,840
Sand and gravel——do——	392,090	$439,054	364,719	454,660
Stone——do——	(2)	(2)	——	——
Unapportioned (raw clay, gold, natural gas, silver, and item indicated by footnote 2)——	——	674,303	——	495,734
Total value——	——	1,113,357	——	954,234

SUTTER COUNTY

Production in Sutter County in 1947-48 consisted of raw clay, natural gas, and sand and gravel.

TEHAMA COUNTY

Minerals produced in Tehama County were: 1947-sand and gravel and stone; 1948-sand and gravel.

TRINITY COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Copper——pounds—	(2)	(2)	——	——
Gold——troy ounces—	13,905	$486,675	7,930	$277,550
Sand and gravel——short tons—	(2)	(2)	8,845	12,025
Silver——troy ounces—	(2)	(2)	1,011	915
Stone——short tons—	(2)	(2)	19,900	20,520
Unapportioned (items indicated by footnote 2)——	——	74,880	——	——
Total value——	——	561,555	——	311,010

TULARE COUNTY

Product	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay, raw——short tons—	——	——	(2)	(2)
Natural gas——M. cu. ft.	(2)	(2)	10,672,000	$1,465,000
Sand and gravel——short tons—	(2)	(2)	236,646	290,205
Stone——do——	92,040	$132,457	(2)	(2)
Tungsten concentrates (60% WO_3 basis)-do-	(2)	(2)	138	197,025
Unapportioned (items indicated by footnote 2)——	——	1,395,094	——	105,515
Total value——	——	1,527,551	——	2,057,745

TUOLUMNE COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Copper---pounds-	12,000	$2,520	-------	-------
Gold---troy ounces-	4,232	148,120	1,314	$45,990
Silver---do---	2,015	1,824	1,113	1,007
Soapstone---short tons-	(2)	(2)	-------	-------
Stone---do---	43,330	252,189	33,100	223,851
Unapportioned (lime, sand and gravel and item indicated by footnote 2)---	-------	496,414	-------	579,494
Total value---	-------	901,067	-------	850,342

VENTURA COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Natural gas---M cu. ft.-	47,457,000	$4,517,000	46,023,000	$4,359,000
Natural gasoline and allied products:				
Natural gasoline---gallons-	109,635,000	8,008,000	101,837,000	8,411,000
Liquefied petroleum gases---do---	40,451,000	803,000	34,915,000	2,196,000
Petroleum---barrels-	26,860,000	48,861,000	28,617,000	71,790,000
Sand and gravel---short tons-	676,173	(2)	664,252	549,716
Unapportioned (raw clay, stone, and item indicated by footnote 2)---	-------	618,862	-------	237,530
Total value---	-------	62,807,862	-------	87,543,246

YOLO COUNTY

Product	1947		1948	
	Quantity	Value	Quantity	Value
Sand and gravel---short tons-	167,650	$70,276	195,050	$84,673
Stone---do---	(2)	(2)	45,500	12,250
Unapportioned (mercury, natural gas, and item indicated by footnote 2)---	-------	191,152	-------	47,947
Total value---	-------	261,428	-------	144,870

YUBA COUNTY

Production in Yuba County in 1947-48 consisted of gold, crude platinum metals, sand and gravel, and silver.

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*These figures are furnished by the United States Bureau of Mines in cooperation with the California State Division of Mines.

1/ According to U.S. Bureau of the Census. Value not included in county total.

2/ Value included with "Unapportioned".

3/ U.S. Bureau of the Census not at liberty to publish figure. Value not included in county total.

4/ Natural gasoline and liquefied petroleum gases processed in Kettleman Hills oil field came from gas produced in both Kings and Fresno Counties. Such production is here assigned entirely to Kings County, because figures by county are not available.

5/ A small quantity of crude gypsum produced in Kings County is included with Kern County.

6/ Bureau of Mines not at liberty to publish figure. Value not included in county and state totals.

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Ferry Building, San Francisco 11
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MINERAL INFORMATION SERVICE

VOL. 3 February 1, 1950 No. 2

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

DIVISION OF MINES OPEN HOUSE

Dr. Claf P. Jenkins, Chief, Division of Mines, extends to you a cordial invitation to the open house which is to be held in San Francisco at the Ferry Building on March 7, 1950, from 9 A.M. to 5 P.M. At that time, the Division will open to the public for the first time its new mineral testing laboratory which was designed to accomodate the unprecedented increase in the number of samples submitted for identification.

Tours will start at the information counter on the mezzanine floor of the Ferry Building and will be conducted at regular intervals by staff members through the various offices of the Division of Mines.

CALIFORNIA TOPOGRAPHIC MAPS

The State of California, Department of Public Works, Division of Water Resources, announces that the following topographic maps of areas in California have become available recently:

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Location of S.E. Corner Latitude Deg.	 Min.	 Longitude Deg.	 Min.	Name	Scale	Contour Interval in feet
				Reprints with Corrections		
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Latitude Deg.	Latitude Min.	Longitude Deg.	Longitude Min.	Name	Scale	Contour Interval in feet
33	45	117	52½	Anaheim	1:24,000	5
36	37½	119	15	Citrus Cove	1:24,000	5-25
38	30	120	45	Fiddletown	1:24,000	40
38	30	120	52½	Latrobe	1:24,000	40
39	15	121	15	Oregon House	1:24,000	25
39	22½	121	15	Rackerby	1:24,000	25
39	37½	121	52½	Ord Ferry	1:24,000	5

PYROPHYLLITE

Abridged from a paper by John F. Lance of Whittier College, which was presented at the Los Angeles Fall Meeting of the American Institute of Mining and Metallurgical Engineers, October 21, 1949.

Pyrophyllite is a widely distributed industrial mineral closely related to talc in structure, properties, and uses. It is a soft, light-colored hydrous aluminum silicate ($Al_2Si_4O_{10}(OH)_2$) having a platy crystal structure, greasy feel, perfect basal cleavage, and pearly luster. The crystal habit varies: fibrous, flaky aggregates with or without orientation, light brown or light green radial fibrous groups or rosettes, and compact, fine-grained aggregates are common forms. Under the microscope pyrophyllite is not readily distinguishable from talc or sericite.

Most uses of pyrophyllite closely parallel those of talc because of the great similarity in physical properties of the two minerals. Both are employed in paints as extenders and flake pigments. Properties of the two minerals such as softness, flakiness, light color, and resistance to corrosion, weather, and fire underlie their use as fillers in paper, roofing paper, rubber goods, linoleum, oil cloth, wall plaster, textiles, rope and string, soap, flooring material, asbestos shingles, plastics, battery cases, and other products. They are also used as lubricants and in mildly abrasive compounds for polishing lacquered surfaces, foodstuffs, etc. High absorptive qualities and flakiness make some pyrophyllite particularly suitable as a carrier in insecticides.

Increasing use has been made of pyrophyllite in ceramic industries. It increases the firing range of wall-tile bodies and also decreases shrinkage and cracking by by thermal shock or moisture expansion. Pyrophyllite is also used in semi-vitreous dinnerwares and in certain types of refractories.

The characteristics desired in pyrophyllite depend upon the nature of the particular product in which it is to be used. Most commercial pyrophyllites contain small percentages of such impurities as iron, titanium, calcium, magnesium, sodium, and potassium. To a certain extent the chemical analysis may be useful in predicting the behavior of the raw material to be used in the ceramics industry, but because of the importance of a number of physical and pyro-physical properties and factors involving mining and milling processes, the use of pyrophyllite in ceramic bodies must be controlled by empirical methods.

Mineral impurities in pyrophyllite are usually those connected with the formation of the rock; these include such minerals as quartz, sericite, feldspar, pyrite, sphene, and epidote. In North Carolina mines some free quartz is removed by hand-sorting, pyrite being removed by air separation and electro-magnets. In the San Diego County deposits, free silica and unreplaced country rock are removed by mechanical and hand sorting. Some mineral impurities are not undesirable in pyrophyllite to be used in whiteware bodies. The best results are usually obtained from pyrophyllitic rock containing 77-80% silica and 1.8-2.0% alkalies, providing the free silica is finely divided and the alkalies are contained in the mineral sericite. Theoretically pure pyrophyllite contains 66.7% SiO_2, 28.3% Al_2O_3, and 5% H_2O.

Most pyrophyllite deposits have been formed by hydrothermal alteration or metasomatism of acid and intermediate volcanic rocks. The nature of the altering solutions is generally considered to be acidic and factors governing the formation of pyrophyllite seem to be the Al-Si ratio in the original rock, K ion concentration, pH value of solutions, and temperature. Laboratory experimentation indicates that pyrophyllite probably forms from alteration of feldspars in acid solutions within a temperature range of 300° to 540° C. Adjacency to fissures along which altering solutions could have gained access seems to be a field feature of all pyrophyllite deposits. Some appear to have formed under directed shearing pressures of variable strength.

California commercial deposits now active are largely confined to the San Dieguito area of western San Diego County. Commercial exploitation began at the Pioneer mine in 1945. The pyrophyllite occurs in the Santiago Peak volcanic series which have been intruded by a variety of granitic rocks. Pyrophyllitization of pyroclastic and flow volcanic rocks varying in original mineral content from rhyolite to andesite has been noted. Most of the production at the Pioneer mine has gone into insecticides.

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MANGANESE

Manganese, a gray-white semi-metal resembling iron, ranks twelfth in abundance among the elements of the outer crust of the earth. Its alloys with copper, iron, and nickel are exceedingly important to American industry. Manganese deposits are rather widely distributed in California but are relatively small in size and ordinarily are exploited only under wartime conditions. Manganese is somewhat harder than iron, is very brittle, has a m.p. of 1260° C., a b.p. of 1900° C., and a sp. gr. of 7.2.

Economically important manganese minerals found in California ore bodies are pyrolusite (MnO_2), psilomelane ($BaR_9O_{18}\cdot 2H_2O$ where R = Mn, valence 4 or 2 plus cobalt), manganite ($MnO(OH)$), cryptomelane (KR_8O_{16} where R = Mn, valence 4 or 2 plus Zn or Co), rhodochrosite ($MnCO_3$), hausmannite (MnO, Mn_2O_3), and braunite ($3(Mn,Fe)_2O_3\cdot MnSiO_3$). Two other manganese minerals common in California deposits but so far not economically exploitable are the silicates rhodonite ($MnSiO_3$) and bementite ($8MnO\cdot 5H_2O\cdot 7SiO_2$). Common occurrence of intimate mixtures of minutely crystalline manganese minerals in oxide ores has led to considerable confusion in nomenclature and descriptive mineralogy of such ore minerals. Minerals of many oxide ores cannot be distinguished one from another by their apparent physical characteristics in hand specimens. X-ray and other elaborate laboratory methods are often necessary for reliable determination. This is particularly true of mixtures of one or more of the minerals; pyrolusite, psilomelane, manganite, and cryptomelane. In general, massive, hard, heavy oxide ore not specifically identified as to mineral content should be referred to as "psilomelane type"; massive, soft material of low apparent specific gravity should be called "wad". California commercial ores are of six types:

1. Black oxides - mixtures of the black manganese minerals as mentioned above. The bulk of California manganese ore thus far marketed is of this type.

2. Hausmannite - composed essentially of the dark reddish-brown mineral hausmannite. This type is important at the Blue Jay mine in Trinity County and at several mines in San Luis Obispo County.

3. Braunite - a hard, dense, steel gray oxide-silicate ore type. Braunite is soluble in hydrochloric acid and leaves a gel-silica residue when so treated. The mineral is the principal constituent of ore in the Braito mine, Plumas County, and the Fort Seward mine in Humboldt County.

4. Rhodochrosite - Commonly a dense, granular, light colored ore varying in color from pink through reddish-gray to gray. Rhombohedral rose-pink crystals occasionally are prominent in the ore. Rhodochrosite is a carbonate mineral prominent in a great many California mines, notably in Trinity, Stanislaus, and Humboldt Counties.

5. Wad - an impure, earthy, bedded, ore type containing oxides of manganese, iron, and other metals mixed with clay and miscellaneous impurities. California occurrences of wad-type ore are largely confined to a small area at the border of San Bernardino and Inyo Counties in the vicinity of Owls Spring.

6. Manganiferous iron - ores of this type are red, reddish-brown, or yellowish-brown and usually are high in iron and low in manganese. The silica content is commonly high, silica minerals being chiefly opal and jasper. Iron minerals may be ochrous or specular hematite or limonite. Deposits of this type occur in Lake, Mendocino, and Napa Counties, but the manganese content has generally proven too low to make them economic.

Four general types of manganese deposits based on genesis and environment can be recognized in California. Several of these are capable of further subdivision. The most important type consists of bedded lenses occurring in chert of marine origin. Interbedded chert and manganese ore are generally regarded as having been deposited contemporaneously in basins on the sea floor where manganese carbonate and silica were being added to the sea water by volcanic activity, perhaps hot springs. Close association of such deposits with basic volcanic rocks is almost universal in California. Iron often occurs with manganese in bedded accumulations of this category. Some examples of this type of deposit have been metamorphosed so severely that their original nature is obscured.

A second type of bedded deposit occurs in Tertiary lakebed sediments in the vicinity of Owls Spring, San Bernardino County. Little is known concerning the origin of this manganese, but the deposition is sedimentary. No production has been reported from this type of material.

The third type of deposit consists of veins or fissures filled with manganese minerals and of manganese-impregnated rocks adjacent to such fissures. A small tonnage of material of this type has been mined.

Manganese oxide replacements in limestone and in a few other types of host rock form the fourth type of deposit. In some cases replacement bodies can be shown to be related to adjacent fissure deposits; in others the source of the manganese is not known. Some ore of this type was shipped during World War I.

Manganese deposits are known in 44 of the 58 counties of the state, but most of the manganese ore thus far mined in California has come from cherty members of the Franciscan formation of the Coast Ranges. California, in war time, has been one of the principal producers in the United States, but the total domestic production of manganese has never met the domestic demand. During the peak year of 1944, California production was 30,263 tons; from 1941 to 1944 the state production was more than 50,000 tons. Montana was the only state which exceeded this figure over the same period. Since the war, however, production has dropped and no manganese ore was marketed during 1946 and 1947

Most manganese ore is shipped in much the same condition as it comes from the mine, but in some localities mechanical concentration is possible. The oxide ores of California are not amenable to mechanical concentration, and hand sorting is the only practical means of improving the shipping grade. Rhodochrosite ores can be concentrated by flotation and some low grade ores can be leached to recover the manganese. So far, economically feasible flotation and leaching methods of concentration for California ores have not been found.

More than 90 percent of all manganese used in the United States is consumed by the iron and steel industry. In furnace practice, manganese is employed as a scavenging agent for removing oxygen and sulfur for controlling the carbon content, and as an alloying element. As an alloying material, manganese ore is commonly introduced to the blast furnace mix to form manganiferous pig iron. Manganese is also added to various steel melts in the form of ferromanganese, silicomanganese, or spiegeleisen (manganese-rich cast iron). Manganese adds toughness and strength to some types of steel and a high degree of work-hardening to others. Small tonnages of manganese are also used in making alloys with copper, zinc, aluminum, and magnesium.

The manufacture of dry-cell batteries consumes large tonnages of manganese ore annually. High grade oxide ores are required for this purpose; these should be high in available oxygen and low in metals such as iron, copper, nickel, cobalt, and arsenic. Suitability of ores for this purpose is commonly tested by making sample dry cell batteries and subjecting them to standard discharge tests.

Minor uses of manganese are in:

1. Glass manufacture - as a decolorizer of optical glass and as a coloring agent for black glass.
2. Ceramic glazes.
3. Welding rod coatings.
4. Drying agents for paint, varnish, and printing ink.
5. Fertilizer - in the form of manganese sulfate.
6. Miscellaneous industrial chemicals.

During 1948, domestic production of manganese ore furnished 11 percent of the total domestic manganese consumption. Imports of ore totaled 1,300,000 short tons, including 1,220,000 tons of metallurgical grade and 80,000 tons of battery and chemical grade. In addition, ferromanganese was also imported.

A standard specification for metallurgical grade ore is:

Mn	48%
Fe	6%
$SiO_2 + Al_2O_3$	11%
P	0.12 or less

Battery grade ore should contain approximately 70% MnO_2. Prices are nominal and subject to negotiation, but 79 to 81 cents per long ton unit on a basis of 48% Mn is a recently quoted price for metallurgical ore. Domestic chemical grade ore, 70 to 72 percent MnO_2, is quoted at $45 to $50 per ton in carload lots, f.o.b. mines.

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Mine Production of Gold, Silver, Copper, Lead, and Zinc in California in 1949, by Months, in Terms of Recovered Metals*

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	30,170	62,790	80	810	600
February	32,090	73,880	70	1,010	810
March	34,660	73,350	110	940	1,060
April	35,620	82,900	70	880	950
May	32,810	79,270	80	860	820
June	35,210	66,550	60	910	630
July	33,850	30,430	30	450	90
August	35,180	30,410	30	360	150
September	34,250	55,600	30	710	290
October	36,200	80,440	30	1,100	650
November	34,920	74,270	30	1,010	610
December	35,350	76,410	40	1,090	640
Total: 1949	410,310	786,300	660	10,130	7,300
1948	421,473	724,771	481	9,110	5,325

Mine Production of Gold, Silver, Copper, Lead, and Zinc in California, 1945-1949, in Terms of Recovered Metals*

Year	Gold		Silver		Copper		Lead		Zinc		Total Value
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1945—	147,938	$5,177,830	986,798	$701,723	12,946,000	$1,747,710	14,448,000	$1,242,528	19,846,000	$2,282,290	$11,152,081
1946—	356,824	12,488,840	1,342,651	1,084,862	8,480,000	1,373,760	19,846,000	2,163,214	13,754,000	1,677,988	18,788,664
1947—	431,415	15,099,525	1,597,442	1,445,685	4,814,000	1,010,940	20,160,000	2,903,040	10,830,000	1,310,430	21,769,620
1948—	421,473	14,751,555	724,771	655,954	962,000	208,754	18,220,000	3,261,380	10,650,000	1,416,450	20,294,093
1949—	410,310	14,360,850	786,300	711,641	1,320,000	260,040	20,260,000	3,221,340	14,600,000	1,868,800	20,422,671

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*These figures are furnished by the U.S. Bureau of Mines, with which this Division has a cooperative agreement.

GOLD

Gold most often occurs as the native metal alloyed with varying amounts of silver. Less commonly it is found in chemical combination with tellurium as sylvanite, $(Au,Ag)Te_2$, calaverite $AuTe_2$, and petzite $(Ag,Au)_2Te$. Gold crystallizes in the isometric system but crystals are usually distorted into dendritic or leaf-like aggregates. More often gold shows no apparent crystallinity but is found finely disseminated through its ores. The metal is soft, malleable (grains will flatten instead of breaking when struck with a hammer), ductile (capable of being drawn out), and very heavy (sp.gr. 19.3 when pure). Gold is not affected by any single acid. Its color intensity is dependent upon the amount of silver present; gold alloyed with large amounts of silver has a green or even brassy cast.

Calaverite varies in color from pale yellow to silvery white with a brassy cast. Crystals are small, striated, and lath shaped, and belong to the monoclinic crystal system. The mineral has a hardness of 2.5 and sp.gr. of 9.0. The gold content of the pure mineral is 44 percent. Sylvanite is probably the most abundant telluride of gold in California and has been an important ore mineral in some Mother Lode mines. It is silvery white to steel gray in color with a bright metallic luster and prominent cleavage. Hardness (1.5-2) and sp.gr. (7.9-8.3) are somewhat less than for calaverite. The gold content of sylvanite is 24.2 percent. Petzite is steel gray to iron black in color and tarnishes to a dull black. It is massive, granular, and compact; and brittle to sectile in tenacity. Hardness is 2.5-3 and sp.gr. 8.7-9.0.

Lode gold may be associated with a wide variety of ore and gangue minerals but in a majority of California mines it is associated with pyrite (FeS_2) and quartz (SiO_2). Gold in vein ores is usually not visible to the naked eye unless the grade of the ore is high. In oxidized gold ores gold is commonly coated with limonite (hydrous iron oxide) and may not be visible even in high grade specimens.

Placer gold is usually associated with other heavy ore minerals such as magnetite, ilmenite, chromite, monazite, rutile, and zircon. Platinum and diamonds have been found in the gold placers of Butte County but both are rare.

Gold has been mined in almost every county in California, but the quartz veins of the Mother Lode and Grass Valley districts of the central Sierra Nevada and placers derived from these and related lode systems have been by far the most productive.

The most important gold deposits of California are the following:

1. Stream placers of Recent and Quaternary age and buried placers of Tertiary age.
2. Vein or lode deposits.

Prior to 1880 and especially during gold rush days, gold came predominantly from placers. Since 1880 considerably more gold has come from lodes than from placers.

Owing to high post war operating costs and the unchanged price of gold, mining of the metal is now at a low ebb in California. The several dredges operating in Sacramento Valley and two operators of lode mines in the Grass Valley district now account for most of the California production. Hydraulic mines, even where debris dams have been constructed must curtail operations because of diversion of the water supply for irrigation and metropolitan consumption.

Gold-mining methods have been numerous and varied. Early placer deposits were exploited by pan and sluice box. Later, hydraulicking and dredging became common placer practice. With the development of lodes and underground placers or drift mines, underground methods of exploitation became increasingly important and most of the known techniques of gold mining have been employed in various California mines. Many of the best known methods of mining in deep mines were developed in California.

Treatment of most gold ores involves pulverizing, plus one or more of such methods as gravitational concentration, amalgamation, cyanidation, floatation, and smelting. The mill practice usually depends upon the physico-chemical character of the ore and upon various economic considerations such as power supply, accessibility to transportation, etc.

As gold has been banned by the Federal Government for coinage, it is now used principally in jewelry and dentistry. Although the standard price of gold has remained at $35.00 per ounce through the inflationary period, it is now legal to sell gold in its "natural state" on the domestic market without a license at any price obtainable. Gold in the "natural state" includes free-milled gold and unretorted amalgam. Gold which has been cyanided, smelted, or retorted would not be salable except to United States mints or to persons licensed by a mint. A mint-license is required for melting gold. For complete regulations and marketing information on gold write or consult the office of the U.S. Mint located at Duboce and Market Streets in San Francisco, California. California gold buyers must be licensed by the California State Division of Mines.

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CORRECTION TO REFERENCE

Correction to reference list of recent publications published in the October MINERAL INFORMATION SERVICE, Volume 2, Number 10.

Sawyer, Frederick G., Ohman, M.F., and Lusk, E.F., Iodine from oil well brines: Ind. and Eng. Chemistry, vol. 41, no. 8, pp. 1547-1552, 1 flowsheet, 5 photos, 1 graph, August 1949. Discusses the blowing out process developed by the Dow Chemical Company and used at the Seal Beach, Venice, and Inglewood plants.

RECOMMENDATIONS OF THE GOVERNOR'S CONFERENCE ON EMPLOYMENT

At the Governor's conference on Employment held at Sacramento, December 6, 1949, Section S (Transportation, Communications, Utilities and mineral extraction) of the Conference among others, adopted the following recommendation:

"1. For creating an Advisory Committee to act in conjunction with the State Division of Mines in order to expand the program of investigating and coordinating the known and probable needs of industry and agriculture for metals and nonmetallics with the known and probable resources of the State. In this program, the Division should encourage and make use of the research, both basic and applied, which can be accomplished by universities, private agencies and similar groups and the Division should receive increased appropriations as needed to carry out this program."

"2. For making representations for an early and definite solution to the problem of the ownership of the Tidelands Oil deposits."

PINE CREEK TUNGSTEN MINE*

The Pine Creek tungsten deposit, located about 25 miles west of Bishop, is a contact metamorphic orebody lying between walls of granodiorite and limestone. Mineral content consists of scheelite, molybdenite, and chalcopyrite in a gangue of garnet, epidote, wollastonite, calcite, fluorite, and powellite.

A 1200 ton-per-day combined flotation and chemical plant is connected with the mine by a 2-mile aerial tram. Flotation recovery of scheelite is excellent, and the chemical plant produces a concentrate which is low in molybdenum.

The shrinkage stoping method was in use before a diamond-drill blast-hole method patterned after that developed at the Noranda mine in Quebec was adopted. Mining during the past three years has been a scavenging operation wherein production has been maintained by open pit work and by side slabbing ore from the old stope walls by means of long diamond-drill blast holes.

A long exploration adit known as the Zero Tunnel, designed to tap the ore at an elevation 1500 feet below the old workings, was started in 1943 and completed in December 1947, to show the downward extension of the ore. Widening of the 7400-foot tunnel was essential because water flows amounting to more than 5000 gallons per minute had been encountered. Two methods were used; in one of these advantage was taken of the fact that cherry-picker stations had been cut at intervals of 200 feet from the 300-foot compressor installation to the 7,000-foot station. From these cherry-picker stations two diamond drill holes, one foot and five feet above the track, were drilled 100 feet in both directions, parallel to and 12 feet from the right rib of the tunnel. One hundred feet of hole was loaded at a time and blasted with Rockmaster caps. In some sections the widening was accomplished by ring drilling at intervals of 2½ feet with DA35 drifters set up on a 5-machine jumbo. This jumbo consisted of a horizontal bar attached by universal clamps to sections of 4-inch drill column welded to two loaded ore cars. For ditching, two down holes, spaced 2½ feet apart, were drilled with Ingersoll-Rand DA35 drifters mounted on a battery locomotive.

A crushing plant and other surface buildings were completed in 1949 at the portal of the Zero Tunnel. The tipple, coarse ore bin, and crusher are in one building connected by a tunnel and conveyor shed to the fine ore bin. The base of the fine ore bin is built into the tramway terminal.

A rotary tipple dumps into a 150-ton coarse ore bin. The ore is fed to a crusher by a 4-foot by 16-foot Sheridan grizzly driven by a 50-hp variable speed wound rotor motor. The crusher is a Traylor 36-inch by 48-inch jaw crusher, Type HB, driven by V belts and powered by a 150-hp, 870-rpm induction motor. Crushed product averaging 3 inches to 5 inches is handled by a Link-Belt conveyor equipped with a 30-inch rubber belt, 185 feet in length, which discharges into a 1,000-ton live storage bin resting on a concrete base. Tram buckets are loaded from the storage bins by three 30-inch Link-Belt heavy duty apron feeders fitted with manganese steel pans. These feeders operate at a speed of approximately 20 feet per minute and are driven by 15-hp, 56-rpm, gear motors.

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*Summary of paper presented at Los Angeles meeting of the American Institute of Mining and Metallurgical Engineers, October 20, 1949, by David D. Baker.

ACKNOWLEDGMENT

The Division of Mines announces the recent acquisition of the following volumes by its technical library. We wish to thank Mrs. Hansen, Mr. Young, Mr. Witt, The Standard Oil Library, and others who so promptly and generously responded to our notice in the January issue of MINERAL INFORMATION SERVICE regarding publications needed for the Division Library.

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MINERAL INFORMATION SERVICE

VOL. 3 March 1, 1950 No. 3

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

SEVENTY YEARS OF PROGRESS

THE DIVISION OF MINES
EXTENDS TO YOU A CORDIAL INVITATION TO AN OPEN HOUSE
TO BE HELD AT THE FERRY BUILDING
IN SAN FRANCISCO
TUESDAY, MARCH 7, 1950, 9 A.M. TO 5 P.M.

Since 1848, gold and other minerals hidden in the rocks and rivers of California have attracted miners, prospectors, and pioneers from all parts of the world. As early as 1853 the legislature of the young state established the First Geological Survey to study California's mineral wealth. Dr. John B. Trask, who already had made a three-year study of the Sierra Nevada, was appointed State Geologist and served in that capacity until 1856. His work is recorded in three reports which contain geological and mining information of considerable value. The Second Geological Survey under the guidance of Josiah D. Whitney, was in existence from 1860 to 1873. Eight volumes on geology, paleontology, botany, and ornithology were published as a result of the scientific work of this survey.

The State Mining Bureau was created in 1880 as an economic and scientific survey, and for 70 years has continued this work. In 1927, its name was changed to Division of Mines and Mining, and it was made a division of the Department of Natural Resources; in 1929 its name was shortened to Division of Mines.

The first office of the State Mining Bureau was a small room at 619 Montgomery Street. This was occupied for two months, until larger rooms at 313 Pine Street were found. These, however, were occupied only a year, as the building was razed in June 1881. The donation of many specimens and books to the museum and library of the new Bureau by the California State Geological Society made still larger quarters necessary, and a suite of rooms at 212 Sutter Street, over a stable, was taken. A series of robberies, the danger of fire, and disagreeable odors made this building unsatisfactory, and in December 1885, the Mining Bureau was moved to 24 Fourth Street. Four years later, the Bureau secured space in the new Ferry Building, where it is still located. Today the Division's quarters house the most comprehensive exhibit of mineral specimens west of the Mississippi River, and a library containing more than 9000 volumes on geology and mining. Its publications on mining, geology, and related sciences are distributed not only in California but throughout the world.

On March 7, 1950, from 9 a.m. to 5 p.m. the Division will open to the public for the first time its new mineral testing laboratory. Colored motion pictures depicting California and its natural resources, and the mining and processing of lead, zinc, and nickel, will be shown throughout the day; short talks will be given by staff geologists on clay, pumice and perlite, and gypsum; and tours through the Division's offices, starting at the information counter on the mezzanine floor of the Ferry Building, will be conducted by staff members. You are cordially invited to attend.

ESTIMATE OF CALIFORNIA MINERAL PRODUCTION 1949

The total value of minerals produced in California for the year 1949, as estimated by the Division of Mines, is $1,103,127,000. The year's output is detailed in part in the tabulation below. As more than sixty mineral substances are produced in the state, estimates are possible on only the most important at this date. Request for reports on 1949 production are being mailed to all producers by the U.S. Bureau of Mines in cooperation with this Division, and a complete report will be published when the returns have been received and compiled. The preliminary figures on copper, lead, gold, silver, and zinc below are estimates of the U.S. Bureau of Mines.

The estimated total value of $1,103,127,000 is a decrease of approximately $71,547,000 from the 1948 total value of $1,174,674,000. The decrease in the total value of mineral production for the year was due to a decrease in the quantity of petroleum produced and lower prices for the lower gravity crude oils. Increases in quantity and value were shown by silver, copper, zinc, natural gas, natural gas gasoline, and liquefied petroleum gases, whereas decreases were shown in quantity and value of petroleum, gold, mercury, cement, miscellaneous stone, and sand and gravel.

The petroleum output for 1949 decreased approximately 6,321,000 barrels or about 2 percent in quantity and about $70,448,000 or approximately 9 percent in value from the 1948 totals. The decrease in quantity and value of petroleum resulted from several cuts in prices paid for the lower gravity crude oils and the shutting-in of wells producing these oils. On January 25, 1949, the first reduction in crude oil prices was made on oil of less than 20 gravity and was as much as 20¢ on the lower gravities. Again on April 1st cuts were made on low gravity oils, as much as 40¢ on the heaviest crudes. Further reductions, as much as 21¢ on heavier crudes, and some increases in price, as much as 28¢ on the lighter ones, were made on June 1st. The final adjustment in petroleum prices came on September 3rd when a cut was made in quotations on crudes of 26 gravity and lower, with cuts as much as 35¢ on lower gravities. A maximum decrease of as much as $1.18 on the heaviest oil in some fields was registered during the year. The output of natural gas (utilized), natural gas gasoline, and liquefied petroleum gases all showed increased outputs with record total values for the year.

TABULATION OF ESTIMATED MINERAL PRODUCTION IN CALIFORNIA FOR 1949

Gold	$14,361,000	(410,310 fine ounces)
Silver	712,000	(786,300 fine ounces)
Copper	260,000	(1,320,000 pounds)
Lead	3,221,000	(20,260,000 pounds)
Zinc	1,869,000	(14,600,000 pounds)
Mercury	516,000	(6,500 flasks of 76 pounds)
Other metals	3,250,000	(including chromite, iron ore, molybdenum ore, platinum metals, and tungsten ore.)
Petroleum	753,248,000	(333,768,000 barrels)
Natural gas	66,244,000	(584,138,000 M cu. ft.)
Natural gas gasoline	71,622,000	(867,090,000 gallons)
Liquefied petroleum gases	17,080,000	(271,104,000 gallons)
Cement	57,394,000	(23,050,000 barrels)
Miscellaneous stone, sand and gravel	41,500,000	
Clay products	22,000,000	(Heavy clay products other than pottery and refractories)
Other industrial non-metallic minerals	16,100,000	(including clay, diatomite, gypsum, lime, pumice, talc, and others)
Salines	33,750,000	(including borates, iodine, magnesium salts, potash, salt, sodium salts, and others)
Total value	$1,103,127,000	

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MONAZITE AND THE RARE-EARTH ELEMENTS

The rare-earth elements are a group of fifteen metallic elements comprising atomic numbers 57 to 71, inclusive, in the periodic table. In order, these are: lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), illinium (Il), samarium (Sa), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), and lutecium (Lu), or cassiopeium (Cp). Although scandium, yttrium, and thorium are not in the rare-earth group, they always occur in considerable quantities in the rare-earth minerals and have to be considered in all separations. The group constitutes about 0.005 percent of the earth's crust, with cerium providing nearly one-third of the total. Thus cerium is more abundant than such "common" elements as tin, mercury, cadmium, antimony, bismuth, and tungsten.

The principal source of the rare-earth elements is the mineral monazite, found as an alluvial sand in Brazil, India, and Australia. Monazite is a complex monoclinic phosphate, containing often as much as 70 percent cerium with thorium present, probably as the silicate. Other important mineral sources are gadolinite (a silicate), fergusonite (a columbate and tantalate), samarskite (a tantalate and uranate), xenotime (a phosphate), yttrocerite (a fluoride), cerite (a basic silicate), bastnasite (a fluocarbonate), and allanite (a silicate). The method selected for the extraction of the rare-earth elements from the ore depends on the nature of the ore and the presence of other elements.

The great similarity in chemical properties of the rare-earth elements has made their separation a problem of extraordinary difficulty. All the cerium metals (La, Ce, Pr, Nd, Sm) have been prepared, most of them in a somewhat impure state. The metals have metallic luster and, in general, appear to be white, gray, or slightly yellow. One of the outstanding properties of the rare-earth elements is the strong magnetism displayed by most of the metals and their compounds. This is useful in identification and determination of purity. Monazite behaves as a weakly magnetic substance, probably owing to the presence of cerium oxide, which is diamagnetic (is repelled by a magnet).

Although some isotopes of samarium and lutecium are naturally radioactive, the chief radioactive constituent of monazite sands is thorium, which may be present in quantities up to 20 percent. Uranium may also appear in minor amounts. The spontaneous radioactivity of monazite sands is frequently useful in discovering deposits. The modern prospector exploring stream bottoms with his Geiger counter may discover radioactive sands. His disappointment in learning that the radioactivity is due to thorium instead of uranium frequently discourages him from investigating the possibility of developing a commercial monazite deposit.

Monazite is commonly honey-yellow in color but may vary from greenish-yellow through reddish-orange to dark brown. The luster is resinous or greasy and the mineral is semitransparent to opaque. The specific gravity ranges from 4.9 to 5.3, and the hardness from 5.0 to 5.5 (about the same as steel). Monazite is very brittle, and crystals and grains can be cracked between the teeth.

In minor quantities monazite is widely distributed in igneous rocks throughout the world, especially in gneisses which have been intruded by pegmatites. The commercial deposits of monazite are the result of decomposition of the rocks containing the mineral and concentration in dunes, stream gravels, and beach sands. The heavy sands commonly consist of ilmenite, magnetite, zircon, rutile, garnet, and monazite in widely varying proportions.

The principal sources of monazite at present are Brazil, India, and Ceylon. Imports of 2,397 short tons of monazite valued at $277,327 came principally from Brazil in 1947. India and Australia do not permit exports of monazite at present. Domestic production is negligible because of the small percentage of monazite contained in known workable deposits. North and South Carolina, Florida, and Idaho formerly produced monazite, but at present prices economic operations are not possible. The Idaho deposits contain from 0.1 to 0.15 percent monazite. The sands are gold-bearing and the monazite was caught as a by-product in the sluice boxes. Many placer deposits worked primarily for ilmenite also yield appreciable quantities of monazite.

In California, traces of monazite have been found in the black sands of Little Rock Creek, Butte County; in the concentrates of "Indian Diggins" district, and at Placerville, El Dorado County; at Michigan Bluff, Placer County; and in the Brownsville district, Yuba County. It has been observed in the black sands at Crescent City, Del Norte County; and at Trinidad, Humboldt County. It occurs in the sands at Nelson Point, Plumas County. In Riverside County, it is a conspicuous constituent of a pegmatite near Nuevo; also in pegmatites near Winchester; and crystals have been found with albite in pegmatite in the Jurupa Mountains.

In April 1949 an important discovery of the rare-earth mineral bastnasite was made in San Barnardino County. The deposit lies near Mountain Pass Service Station on Route 91, 33 miles northeast of Baker, California. Within an area of about 600 by 1500 feet, underlain by Archean rocks, several veins have been located which contain up to 30 percent bastnäsite, (a fluocarbonate of cerium and lanthanum, with thorium and uranium). Other rare-earth minerals not yet identified are also présent. The lodes of the area appear to be of potential commercial value as a source of cerium and lanthanum.

The present market quotation for monazite is 13¢ to 15¢ per pound, on the basis of a content of 65 percent of oxides of the rare-earth elements, including thorium oxide (thoria), and cerium oxide. The requirements of industry are rather limited and sporadic; therefore, specifications of buyers are elastic. Formerly, monazite was utilized for its thorium content but the current basis for valuation is the content of the rare-earth elements. The trade-journals continue to quote prices based on a content of 8 percent thoria. These quotations are nominal and do not indicate that a bona fide demand exists at the quoted price. The only means available for determining the value of monazite sand is by direct negotiation with the buyer. The following is a list of consumers:

Lindsay Light and Chemical Company, West Chicago, Illinois
Maywood Chemical Works, Maywood, New Jersey
National Carbon Company, Inc., 11701 Madison Avenue, Cleveland, Ohio
New Process Metal Corporation, Newark, New Jersey
Woolf-Alport, 1127 Irving Avenue, Brooklyn, New York

Mining methods employed in the recovery of monazite sands have been principally simple sluicing or a combination of hydraulicking and sluicing. The ore is sorted by gravitational, electrostatic, and electromagnetic methods. Careful sizing of concentrates is necessary for maximum recovery during magnetic separation. The latter takes place at a series of tables of increasing electromagnetic strength. With increasing magnetic intensity, the following products are separated: (1) Magnetite; (2) ilmenite and bementite; (3) garnet, platinum, epidote, apatite, olivine, and tourmaline; (4) monazite with minor amounts of zircon, rutile, epidote, and other minerals; (5) fine grains of monazite; and (6) gold, zircon, rutile, quartz, feldspar, and other non-magnetic minerals. Ilmenite, in particular, is a valuable by-product and several deposits are mined for this mineral with the monazite content considered as secondary.

Domestic industry has developed several important uses for the rare-earth elements. Perhaps the largest use is for the oxides and fluorides of the rare-earth elements required in the cores of positive arc electrodes for moving-picture projectors and floodlights. Cerium has become an important constituent in some aluminum, magnesium, and iron alloys to increase strength and hardness. Cerium dioxide is used as a fine abrasive for polishing glass and soft metals, and it is an essential material in the manufacture of gas mantles, which are approximately 99 percent thorium oxide and 1 percent cerium dioxide. Spark-producing cerium alloys are used in cigarette and gas lighters. Salts of rare-earth metals are used in optical and colored glass, mildew-proofing, beauty preparations, opaline enamel, and as chemical catalysts. Thorium is used principally in electron emissive elements such as are contained in vacuum tubes used in radios and for nuclear research.

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Yost, D.M., Russell, H., and Garner, C.S., The rare-earth elements and their compounds: 92 pp., New York, John Wiley and Sons, Inc., 1947.

PRODUCTION AND UTILIZATION OF PETROLEUM IN CALIFORNIA FOR 1949 COMPARED WITH 1948

Most of the crude oil produced in California is sent to storage reservoirs at tank farms near the oil fields and from these reservoirs by pipe lines to the refineries. The larger of the refineries are located in the vicinity of Los Angeles and in the San Francisco Bay area.

The crude petroleum production for 1949 was estimated to be 332,839,000 barrels according to the compilation by E.T. Knudsen in "Monthly California Petroleum Statements for 1949" published by the U.S. Bureau of Mines. The crude oil consumption in the state for 1949 was: refinery input 320,913,000 barrels; transferred to fuel 1,717,000 barrels; shipped outside of the state 6,548,000 barrels; and 2,312,000 barrels received from out of state for local consumption. The stock of crude petroleum was 38,027,000 barrels on December 31, 1949, an increase of 4,400,000 barrels over stock on hand December 31, 1948. For comparison, the following figures are given for 1948: crude petroleum production, 340,089,000 barrels; refinery input, 327,493,000 barrels; crude oil transferred to fuel, 2,135,000 barrels; shipped out of the state, 6,946,000 barrels; received from out of the state, 1,218,000 barrels; and stock on December 31, 1948, 33,627,000 barrels.

PRODUCTION OF PETROLEUM PRODUCTS FOR 1949 AND 1948 AND PETROLEUM STOCKS ON DEC. 31, 1949

Refinery input and transfers	1949	1948	Stocks on hand Dec. 31, 1949
	Barrels of 42 gal.	Barrels of 42 gal.	Barrels of 42 gal.
Crude petroleum to refinery	320,913,000	327,493,000	38,027,000
Crude petroleum transferred to fuel	1,717,000	2,135,000	-------
Condensate	3,087,000	3,299,000	23,000
Natural gasoline	17,080,000	15,989,000	821,000
Liquefied petroleum gases	4,732,000	3,144,000	277,000
Total refinery input	347,529,000	352,060,000	
Refinery production and transfers			
Gasoline and naphtha distillates	135,090,000	125,509,000	20,775,000
Kerosene and kerosene distillates	4,278,000	4,045,000	1,279,000
Lubricating oils, greases, and distillates	4,519,000	3,793,000	2,545,000
Stove oil and diesel oil	49,101,000	48,875,000	14,558,000
Fuel oil	127,677,000	134,357,000	34,453,000
Asphalt and road oil	10,979,000	10,192,000	1,113,000
Coke and other finished products	3,129,000	2,789,000	762,000
Refinery gas and shortage	9,055,000	11,058,000	-------

GEOLOGIC MAP INDEXES AVAILABLE

The United States Geological Survey has published "Geologic Map Indexes" for 15 states. Each index is comprised of a base map of the state with areas covered by geologic maps outlined in color. Date, approximate scale, and references to original publications are given for each geologic map shown on the index.

These maps have been compiled by Leona Boardman, Annabel Brown, and Elaine Watson. The following indexes are now available and may be purchased from the Superintendent of Documents, Washington 25, D.C., or may be consulted in the Division of Mines Library.

By Leona Boardman:
    Idaho, Tennessee, Utah, Washington, Wyoming
By Leona Boardman and Annabel Brown:
    Colorado, Iowa, Kansas, Missouri, Montana, Nebraska, North Dakota, Oregon, South Dakota
By Leona Boardman, Annabel Brown, and Elaine Watson:
    Georgia

CALIFORNIA TOPOGRAPHIC MAPS

The State of California, Department of Public Works, Division of Water Resources, announces that the following topographic maps of areas in California have become available recently:

PUBLISHED FOR GENERAL DISTRIBUTION

Copies may be secured from local distributing agencies or from the Geological Survey, Denver Federal Center, Denver 15, Colorado, at a cost of 20 cents each.

New Mapping

Location of S.E. Corner Latitude Deg.	Min.	Longitude Deg.	Min.	Name	Scale	Contour Interval in feet
33	07½	116	45	Mesa Grande	1:24,000	20
33	07½	116	52½	Rodriquez Mtn. (formerly Roderick Mtn.)	1:24,000	20
33	15	117	15	Morro Hill	1:24,000	20
33	15	117	22½	Las Pulgas Canyon	1:24,000	20
33	22½	117	15	Fallbrook	1:24,000	20
33	30	117	37½	San Juan Capistrano (formerly Arroyo Trabuco)	1:24,000	20
37	45	122	15	Oakland West	1:24,000	5 -25
37	52½	122	00	Walnut Creek	1:24,000	25
37	52½	122	15	Richmond	1:24,000	25
38	00	120	15	Columbia SE	1:24,000	40
38	00	120	22½	Columbia	1:24,000	40
38	07½	120	22½	Murphys	1:24,000	40
38	30	121	22½	Sacramento East (formerly Brighton)	1:24,000	5
39	15	121	22½	Loma Rica (formerly Prairie Creek)	1:24,000	25
39	22½	121	22½	Bangor	1:24,000	25
39	37½	121	15	Brush Creek (formerly Mtn. House)	1:24,000	25

NEW FILM ADDED TO THE LIBRARY

"The Last Ten Feet", a twenty-minute black-and-white motion picture depicting the production and refining of oil has been added to the Division of Mines film library. This film, obtained through the courtesy of the General Petroleum Corporation, brings the total of sound films in the library to five. Other films are:

California and Its Natural Resources (45 min., sound, color)
Ghost Towns (45 min., sound, color)
Prospecting for Petroleum (23 min., sound, color)
Birth of an Oil Field (30 min., sound, color)

These films are 16 mm., and are available for loan or showing to organized groups in California. Prospective borrowers are requested to make arrangements for loans well in advance of the date the film is desired.

ZIRCONIUM

Pure crystalline zirconium is a silver-white metal resembling freshly broken cast iron. The pure metal has a specific gravity of 6.5 and is ductile and malleable. Zirconium has an atomic weight of 91.22; atomic number of 40; melting point of 1860°C; and valence of 2, 3, 4, or 5, with 4 being the most common. At ordinary temperatures zirconium is chemically inert and thus will resist tarnishing. Hafnium, atomic number 72, is a constant associate of zirconium because of the almost identical atomic radii of these two elements and their chemical similarity. Thorium and the rare-earth elements frequently are included in zirconium minerals.

Zirconium has been estimated to constitute 0.02 to 0.03 percent of the earth's crust. It ranks twentieth among the elements in abundance, being more plentiful than nickel, copper, zinc, and lead. Zircon (zirconium silicate) and baddeleyite (zirconium oxide) are the only zirconium minerals occurring abundantly and used as ores. Zirconium lines have been identified in the spectrum of the sun and stars, indicating its presence in these bodies. Zircon is a common constituent of many rocks, particularly granites, syenites and diorites, and of sands resulting from the disintegration of igneous rocks. The so-called black sands, consisting of minerals of high specific gravity, many of which are dark, are commonly rich in minute zircon crystals. Sedimentary rocks often contain zircon because the mineral is hard and chemically resistant to weathering. It occurs more rarely in granular limestones, schists, and gneisses.

Zircon is essentially a silicate of zirconium containing a variable amount of hafnium. The hafnium oxide content varies up to 4 percent in most zircon. Zircon crystallizes in the tetragonal system, and occurs in square prisms and in irregular forms and grains. It is very hard (7.5 on Mohs scale of hardness, where a steel knife blade is 5.5 and quartz is 7); transparent to opaque; and colorless, yellowish, greyish, or reddish-brown. Zircon has an imperfect cleavage, an adamantine luster, a conchoidal fracture, and a specific gravity ranging from 4.6 to 4.7.

As a mineral in sands, zircon is unlike quartz, being brilliant and having a higher specific gravity. It is insoluble in hydrofluoric acid. Ultra-violet light causes many specimens of zircon to fluoresce a brilliant orange, red, or yellow, a phenomenon which has been attributed to the presence of hafnium or uranium in the mineral.

Flawless, transparent zircons are used as gemstones because they are beautiful, durable, and fashionable. Zircons have a high index of refraction and great dispersive power, which produce brilliance and "fire" (flashes of different colors when the zircon is viewed at various angles). The relative abundance of gem-quality zircon has made it comparatively inexpensive. It occurs colorless (jargon or "Matura diamond"), yellowish-red (jacinith), and reddish-orange (hyacinth). Certain brown Siamese zircons when heated change to a blue-green either permanently or temporarily. Australian, Ceylonese, and Siamese gem gravels are the principal sources of gem-quality zircon.

The largest producers of industrial zircon and baddeleyite at present are Australia, India, and Brazil, although there are many other potential sources. Baddeleyite is frequently preferred in industry where the oxide may be utilized directly in manufacturing processes. Baddeleyite is found principally in Brazil, where it occurs in pegmatites, old river deposits, and alluvial sands. Baddeleyite crystallizes in the monoclinic system, having a lower hardness (6.5) and a higher specific gravity (5.5-6.0) than zircon. It is colorless to yellow, brown, or black.

Most of the world's supply of zircon has been produced in Australia as a co-product in the mining of rutile and ilmenite. In 1947 Australia exported 21,894 short tons (2000 pounds per ton) of zircon to the United States. World production in that year was estimated at 30,696 short tons of zirconium concentrates. Of this total, Brazil furnished the United States with 4,619 short tons, principally in the form of baddeleyite. The entire production of zircon in the United States during recent years has been from Florida. In 1946 Florida produced about 4,000 short tons of zircon and the 1948 output is estimated to be more than 12,000 tons. Florida beach deposits have an estimated content of 750,000 tons of material averaging 0.4 percent zircon, 0.1 percent rutile, and 1 percent ilmenite.

Until 1946, most of the Australian concentrates, containing rutile, zircon, ilmenite, and smaller quantities of monazite, were exported as mixed concentrates and separated in the importing country. The Australian government has favored separating the minerals in Australia and exporting zircon and rutile of comparatively high grade in view of the better prices obtainable. This policy has now become fixed because of the requirement under the Australian Atomic Energy Act that the monazite content of the concentrates must be sold to the government.

Zircon is mined chiefly by sluicing and hydraulicking methods. The ore is fed into a concentrator, which is usually either a spiral concentrator or a Wilfley table. The concentrates, which are then drained and dried, contain zircon, rutile, ilmenite, and other heavy minerals. Rotary magnetic separators are used to eliminate the ilmenite, followed by electrostatic separation of the zircon-rutile and cleaning by a magnetic separator. Monazite, when present, is obtained from the electromagnetic separation.

The price of zircon ore containing 65 percent of zirconium oxide, delivered at the Atlantic seaboard and including the costs of insurance and freight, was quoted in February 1950 at $40 to $45/short ton. Possible buyers are:

Titanium Alloy Manufacturing Company, 111 Broadway, New York City
E.J. Wiggans, Pittsburgh, Pennsylvania
Foote Mineral Company, 509 Germantown Trust Building, Philadelphia, Pennsylvania
F.W. Berk, P.O. Box 38, Wood Ridge, New Jersey

Occurrences of zircon have been noted in many California placer deposits although only one has produced commercially to date. The zircon was recovered in a dragline gold dredging operation near Lincoln in Placer County. The concentration of zircon in California sands is generally too low to permit exploitation at current prices. The presence of other commercial minerals accompanying zircon, such as rutile, ilmenite, chromite, gold, and platinum may permit development of a placer deposit if the various minerals can be effectively separated.

The California Division of Mines Bulletin 136, "Minerals of California," lists 25 counties where zircon has been found. Alluvial deposits where zircon is likely to be found may be indicated by layers or patches of black sand. In a beach sand the direction of drift and concentration of heavy minerals is determined by the direction of the prevailing waves and currents. There is evidence that zircon and other heavy minerals are present on the continental shelf. The development of new equipment may make possible the exploitation of minerals from submerged lands lying at a considerable distance from the present shore.

To prepare zirconium oxide and zirconium chemicals, the zircon is commonly heated in an arc furnace with carbon. The silica content vaporizes and the zirconium combines chemically with the carbon. If an excess of carbon is used, the product is zirconium carbide, while if a deficiency is used, a product called "zirconium cyanonitride" is obtained. Both of these compounds can be burned in air to form zirconium oxide, or burned in chlorine to form zirconium tetrachloride. Malleable zirconium may be produced by the following processes: (a) Thermal decomposition of zirconium iodide on a hot filament. (b) Reduction of zirconium chloride with magnesium (Kroll process). (c) Reduction of zirconium oxide with calcium. (d) Reduction of zirconium chloride with sodium.

One of the most interesting properties of zirconium is its great affinity for various gases, such as oxygen, nitrogen, carbon monoxide, carbon dioxide, hydrogen, and water vapor. Considerable quantities of these gases can be absorbed by zirconium at high temperatures and retained permanently in the metal. This property of acting as a "gas sponge" makes zirconium particularly valuable as a "getter" in the production of high vacuum radio transmitting tubes. Owing to its excellent corrosion resistance, zirconium has great promise in the chemical field. It resists all dilute acids and will withstand hydrochloric and nitric acid in hot concentrated solutions. Unlike some other corrosion-resistant metals, however, zirconium will stand up to hot concentrated caustic solutions.

Zirconium and its compounds have attained wide usage in a great variety of industries such as leather tanning, dyeing, ceramics, and manufacturing of various pigments and color lakes for paints and varnishes. Valuable properties of a refractory are a very high melting point, resistance to corrosion, low coefficient of expansion, low thermal conductivity, and long service. Zirconium oxide fulfills these requirements and hence is used to manufacture brick, furnace linings, crucibles, muffles, and porcelain ware. The high specific gravity of zircon is particularly valuable in crucibles for the melting of aluminum, because fragments of the crucible material settle to the bottom instead of floating. In vitreous enamels and ceramic glazes zirconium oxide is replacing both antimony and tin oxide, owing to its nonpoisonous property and excellent opacity obtained from a small percentage of zirconium. As an alloying element, zirconium is used to harden steel and nickel, increase the ductility of tungsten filaments, strengthen copper, and improve certain qualities of aluminum and aluminum alloys. In steelmaking, ferrozirconium acts as a deoxidizer and scavenger to remove oxygen, nitrogen, and nonmetallic inclusions. Metallic zirconium is used in manufacturing ammunition primers, electrodes, photo-flash bulbs, flares, blasting caps, and welding rods for spot welding. Soluble zirconium compounds are used to render textiles water-repellent. Still in the experimental stage are possible applications of zirconium in high-temperature greases, in rubber retardants, and as a precipitant for synthetic textile fibers.

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ACKNOWLEDGMENT

The Division of Mines gratefully acknowledges the gift of the following volumes to its technical library:

U.S. Bureau of Mines, Miners Circular 3, 1911. (Gift of U.S. Bureau of Mines, Reno, Nevada, courtesy Mr. J.B. Zadra.)

U.S. Bureau of Mines, Bulletin 9, 1910. (Gift of U.S. Bureau of Mines, Reno, Nevada, courtesy Mr. J.B. Zadra.)

Twelfth Report of the State Mineralogist of California, 1893-94, two copies. (Gift of Mr. J.J. Doolittle.)

Thirteenth Report of the State Mineralogist of California, 1895-96. (Gift of Mr. J.J. Doolittle.)

U.S. Geological Survey Nineteenth Annual Report, part VI, first part, 1897-98. (Gift of Mr. J.J. Doolittle.)

American Institute of Mining and Metallurgical Engineers, Transactions, vols. 126, 1937; 153, 1943; 163, 1945. (Gift of Mr. E. Walker.)

American Association of Petroleum Geologists, Bulletin, vol. 14, 1930, nos. 1-4, 6-8, 11-12. (Gift of Mr. Quenton L. Brewer.)

American Institute of Mining and Metallurgical Engineers, Transactions, vols. 115, 1935; 128, 1938; 143, 1941; 152, 1943; 161, 1945. (Gift of Mr. Quenton L. Brewer.)

Mining Magazine (New York), vols. 11, 1905; 12, 1905. (Gift of Mr. Quenton L. Brewer.)

Copper Handbook, vol. 8, 1908. (Gift of Mr. Quenton L. Brewer.)

"Wind and Soil", by W.H. Hobbs, excerpt from Scientific Monthly, vol. 57, pp. 289-300, October 1943. (Gift of Mr. K.C. Jones.)

Copper Handbook, vol. 8, 1908. (Gift of Mr. F.H. Dakin.)

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REFERENCE LIST OF RECENT PUBLICATIONS

The references listed below are available for study in the Division of Mines Librar
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Office of Naval Research, Titanium, report of symposium on titanium, Government Printing Office, 157 pp., March 1949. Consists of papers on research and development programs, production, properties, alloys, and metallurgy of titanium. Copies of this report may be purchased from the Superintendent of Documents in Washington, D.C., for 65 cents.

Poland, Joseph F., Ground water in California: Min. Eng., vol. 187, no. 2, pp. 279-284, February 1950. Discusses problems of overdraft and sea-water encroachment in the alluviated valleys of California.

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Volin, M.E., and Matson, E.J., Investigation of the Buckeye manganese deposits, Stanislaus County, California: U.S. Bur. Mines Rept. Inv. 4560, 7 pp., 9 figs., November 1949. Discusses sampling and testing of deposits of rhodochrosite and psilomelane interbedded in Franciscan chert.

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Wiebelt, Frank J., Investigation of the McGuffy Creek chromite deposit, Siskiyou County, California: U.S. Bur. Mines Rept. Inv. 4576, 3 pp., November 1949. Consists principally of sampling and testing data.

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Wright, Lauren A., California talcs: Min. Eng., vol. 187, no. 1, pp. 122-128, January 1950. The four important "talc privinces", all near California's eastern border, are discussed in this report.

MINING AND INDUSTRIAL NEWS NOTES

Tungsten Operation in Inyo County

Development and exploitation of the Yaney mine, located about 5½ miles southwest of Bishop, is well underway. Originally opened up as a gold mine, tungsten ore containing up to two percent WO_3 has been discovered. The principal ore mineral is ferberite ($FeWO_4$) which occurs as small, black, pyramidal crystals in a gangue of opaline silica. This form of ferberite, which is pseudomorphous after scheelite, was once known as reinite. It is the first occurrence of ferberite to be reported from California and will appear in the next supplement to Bulletin 136, "Minerals of California." The deposit appears to be formed by intense alteration and replacement of a normal contact metamorphic scheelite deposit.

Ore is hauled 2½ miles to the Bishop Antimony mine mill for crushing and jig and table concentration. Concentrates are sold to the Molybdenum Corporation of America buyer in Bishop. The Yaney mine and the Bishop Antimony mine mill are under lease to B.W. Van Voorhis of Bishop and R.W. Adams of Lone Pine.

REDDING OFFICE MOVED

The Redding district office of the State Division of Mines is now located in the new State Forestry building at Cypress and Lanning Avenues. The publications and maps of the Division of Mines and standard books on mining, mineral dressing, mineralogy, geology, and related subjects are available there for reference. A stock of the recent publications of the Division of Mines is also kept on hand for the convenience of those wishing to purchase them. Prospectors searching for deposits of radio-active minerals are invited to bring their specimens to the office for Geiger counter tests. No charge is made for the many services of the State Division of Mines, and the public is invited to make free use of them.

The geologists of the U. S. Geological Survey, engaged in mapping portions of the Shasta copper belt, share the new office with the Division of Mines as they have in the past shared the former office on Yuba Street.

Mining pumicite at Shoshone, Inyo County, California. Pumicite is mined from a flat, bed-like deposit and is used as an abrasive in scouring soaps and cleansers.

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NEW PUBLICATION

Announcement is made by Olaf P. Jenkins, Chief, Division of Mines, Department of Natural Resources, that the California Journal of Mines and Geology, Vol. 46, No. 1, January 1950, is now ready for distribution.

This issue contains "Submarine Phosphorite Deposits Off California and Mexico", by K.O. Emery and R.S. Dietz, which summarizes recently acquired information on phosphorite in rock dredgings from the sea floor. "Geology Along the Electra and West Point Tunnels, Amador County, California", by John H. Wiese, Arvid A. Stromquist, John H. Eric, and C. Melvin Swinney, gives the geology as mapped on the route of these tunnels along the north bank of the Mokelumne River, as part of the program of investigations of geology in California in which the U.S. Geological Survey and the Division of Mines are cooperating.

Paul C. Bateman, Max P. Erickson, and Paul D. Proctor's paper on "Geology and Tungsten Deposits of the Tungsten Hills, Inyo County, California", gives the reader an idea of the extent, reserves, outlook for new discoveries of tungsten, and the various mines located in Inyo County. "Geology of the Placerita Oil Field, Los Angeles County, California", by Gordon B. Oakeshott, should be of considerable interest to petroleum producers, as it tells of commercial production being obtained from a poorly defined faulted structural nose, with the producing sands exposed nearby and dipping off basement schists and granitic rocks which are exposed a mile from the field. The occurrence emphasizes possibilities in other similar situations.

"Perlite Deposits in Sonoma County, California", a short paper by Charles W. Chesterman, describes occurrences and types of perlite in this county. Other mineral deposits and the methods used to mine them are described in "Mines and Mineral Resources of Sonoma County, California", by Martin T. Honke, Jr., and William E. Ver Planck, Jr. This paper also includes a tabulated list of each mine and mineral deposit in the county.

This issue also contains the "Annual Report of the State Mineralogist, Chief of the Division of Mines, for the One Hundredth Fiscal Year, July 1, 1948 to June 30, 1949."

Olaf P. Jenkins, Chief
State Division of Mines
Ferry Building
San Francisco 11, California

Date ____________________

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MINERAL INFORMATION SERVICE

Vol. 3 April 1, 1950 No. 4

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

DIVISION OF MINES OPEN HOUSE

In order to acquaint the public with the services and facilities of the San Francisco office of the Division of Mines, an open house was held on Tuesday, March 7. More than 500 professional and lay patrons of the Division were conducted through the museum, offices, library, and laboratory by various staff members. A continuous program of moving pictures on mining and geological subjects interspersed with short talks on several commodities currently under investigation by the staff members was maintained.

The State Mining Board also convened in the office of the Chief of the Division and, during a very stimulating session, discussed the various investigations and services of the Division with participating staff members. The newly enlarged and modernized laboratory with its multiplicity of instruments for testing and research proved to be of particular interest. Many of the latest gadgets were demonstrated to members of the State Mining Board and to other interested parties during the meet.

It has been repeatedly brought to our attention that a large part of the public is still unacquainted with the services, facilities, and work of the Division of Mines. All branches are endeavoring to make their facilities better known and to improve present services. The accompanying photograph depicts a notice placed in the main lobby of the California State Building at Los Angeles by the Los Angeles branch of the Division. The placard brought visitors to the museum and offices in unprecedented numbers, showing that even the State Building traffic was unaware of the facilities within its walls. It is hoped that through dissemination of mail and over-the-counter information and through increased circulation of Mineral Information Service the public can be better informed concerning the Division of Mines activities which it supports.

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INDUSTRIAL MINERALS DIVISION MEETING - A.I.M.E.

The North Pacific Section, American Institute of Mining and Metallurgical Engineers, will be hosts to the Industrial Minerals Division of the Pacific Northwest on April 6, 1950, at Seattle, Washington. The Columbia Section of Spokane, the Oregon Section of Portland, and the Vancouver Branch of the Canadian Institute of Mining and Metallurgy will join in sponsoring the regional meeting. Registration for the sessions will be held in Roberts Hall, Room 211, Mines Building, at 9:00 A.M., and the meetings will begin promptly at 9:30 A.M. Sessions will be held in Roberts Hall and Guggenheim Hall on the University of Washington Campus. A dinner meeting will be held at the Meany Hotel in the University District at 6:00 P.M.

The tentative program now includes papers dealing with industrial minerals and related metals in Montana, Idaho, Oregon, Washington, and British Columbia. Titles are as follows:

"Phosphate Industry in Idaho" - Earl W. Murphy, Boise, Idaho.
"Chemical Phases of the Elemental Phosphorus Industry" - J.G. Miller, Pocatello, Idaho.
"Techniques of Identification of Non-Metallic Materials" - Dr. J.I. Miller, Seattle, Washington.
"Prevention of the Hydration of Lime" - Harold Cahoon, Seattle, Washington.
"Non-Metallic Mineral Resources in Montana" - Dr. E.S. Perry.

Other papers will be announced.

A trip to the Tacoma smelter of the American Smelting and Refining Company is being planned for the morning of Friday, April 7th, for delegates who wish to see this plant. There will also be a trip through the Bethlehem Steel Plant in Seattle on the afternoon of Friday April 7th.

The Cordilleran Section of the Geological Society of America is holding a convention in Seattle on April 7th and 8th, immediately after the Industrial Minerals Sessions, an arrangement which permits interested persons to attend both conventions.

Reservations for luncheon and for dinner must be made in advance of the meeting date, preferably April 3rd, to Drury A. Pifer, Secretary North Pacific Section, A.I.M.E., School of Mineral Engineering, University of Washington, Seattle 5, Washington. George H. Waterman, Manufacturers Mineral Company, P.O. Box 3144, Seattle 14, Washington, is Chairman of the Committee in charge of the meeting.

DISCOVERY OF JADEITE IN CALIFORNIA

Jadeite jade has been found recently as a single stream-rounded boulder in Clear Creek, San Benito County, California. The discovery was made by K.J. Frisch and the late L. Ph. Bolander of Oakland. The jadeite is opaque, grayish green, compact, and very tough, and, although not of gem quality, the find is of unusual geological and mineralogical interest. It is the largest specimen of jadeite yet found in North America.

Jadeite is a pyroxene with fibrous, microcrystalline structure; in pure form it is sodium aluminum silicate, but it commonly contains variable amounts of two other pyroxene molecules, diopside (calcium magnesium silicate) or acmite (sodium iron silicate), with which jadeite forms an isomorphous series. The wide range of color, usually in shades of green, but also white and nearly black, is ascribed to this variability in composition.

In the first examination of the Clear Creek jadeite, made in the Division of Mines laboratories, calcium and magnesium, in addition to sodium, aluminum, and silica, were found, indicating a small admixture of the diopside molecule. Subsequent studies were made by A.F. Rogers of Stanford University and by George Switzer of the U.S. National Museum, Washington, D.C., who have stated, "optical, X-ray, and chemical data show the material to be nearly pure jadeite".

The Clear Creek boulder does not represent the only occurrence of jadeite in California. Two small beach pebbles and one stream pebble have been identified previously by Division of Mines mineralogists. The beach pebbles, reported found north of Eureka, are jadeite of the greenish black variety, called chloromelanite. The stream pebble was found near Dos Rios by E.A. Bacchi of San Francisco. It is translucent, both light and dark green, and of fair quality for polishing.

Further study of these California jadeite specimens is being undertaken by Rogers, Switzer, and members of the Division of Mines staff for publication in the near future.

The term "jade" is applied to either jadeite or to nephrite, which is an amphibole (calcium magnesium iron silicate) possessing a similar fibrous, microcrystalline structure and great toughness. Nephrite has been found in place in many parts of the world and in three separate localities in California, while jadeite occurrences in situ are known only in Burma. Perhaps most of the jade work in China since about 1800 has utilized the Burmese material owing to exhaustion of the ancient nephrite mines of Chinese Turkestan.

THE CALIFORNIA CHLORINE-CAUSTIC INDUSTRY

The chlorine-caustic industry involves the electrolysis of alkali chlorides, either salt or potassium chloride, in order to produce chlorine and caustic. Hydrogen is a by-product. In an overwhelmingly large majority of installations salt is the raw material and caustic soda is the alkali produced. The chlorine-caustic industry ranks among the foremost of the heavy chemical industries and is one of the largest consumers of salt and electric energy. Ten percent of the United States' capacity is attributable to five companies in the west. Their plants are located at Pittsburg, California; Denver, Colorado; Tacoma, Washington; Portland, Oregon; and Henderson, Nevada. In addition, the Clorox Chemical Company produces chlorine and caustic soda in a plant at Oakland, California, but the output is consumed entirely within the plant.

Much of the chlorine is used in the manufacture of chlorinated compounds such as carbon tetrachloride, chloroform, DDT, and a long list of others. Pulp bleaching, textiles, and disinfectants require smaller but significant quantities. Additional amounts are used for water purification and the treatment of sewage. Caustic soda, likewise, is a basic raw material of many industries. The manufacture of chemicals and rayon consumes the greatest quantity, but large tonnages are used in petroleum refining, paper manufacture, cleansers, textiles, and in many other manufacturing processes.

In the early days of the chlorine-caustic industry chlorine was the primary product, and the principal source of caustic soda was the lime-soda process in which sodium carbonate is treated with slaked lime. With the development of new uses for chlorine, electrolytic caustic has become increasingly important. By 1949 the tonnage of caustic soda produced by the lime-soda process had declined to less than 1/3 that produced by the electrolytic method. Today there are no lime-soda plants in the west.

Some 28 different types of cells have been used in the United States, of which 23 types are still in operation. These cells are divisible into two classes, the mercury cell which is popular in Europe and has a minor but increasing application in the United States, and the diaphragm cell which has been installed in a majority of American plants.

The many types of diaphragm cells all operate on the same basic principle. The diaphragm cell contains a graphite anode and an iron cathode, usually in the form of a screen or perforated plate. A porous diaphragm, usually made of asbestos, separates the anode from the cathode and prevents the solution around the anode mixing with the solution around the cathode. A pure concentrated solution of sodium chloride is fed into the anode compartment, passes through the diaphragm, and is withdrawn from the cathode compartment. When a direct current passes between the anode and the cathode, chlorine is liberated at the anode, hydrogen at the cathode, and caustic soda accumulates in the cathode compartment. If the caustic soda were allowed to reach the anode region hypochlorites, chlorates, and other undesirable products would form. If the concentration of caustic becomes high, oxygen and chlorates are liberated at the anode in addition to chlorine. For these and for some other reasons a high decomposition of the brine is avoided. The cell effluent contains from 8 to 11 percent caustic soda and 15 to 18 percent undecomposed salt.

The voltage across the cell is between 3.2 and 4.2 volts. The current varies within wide limits, and the tendency is toward large, compact cells operating at high amperage. Of the 23 types of cells in operation in the United States, 18 operate at about 1000 amperes. Four other types, which produce most of the present output, operate at from 7000 to 16,000 amperes, and a new cell is designed to operate at between 16,000 and 20,000 amperes.

Groups of cells are electrically connected in series, but each cell has an independent brine feed. The effluent from the cells is collected in launders and the gases are collected in mains.

All that has been mentioned above applies to the production of caustic potash by the electrolysis of potassium chloride.

Operations at the Pittsburg plant of the Dow Chemical Company may be divided into three parts, the first of which is the preparation of the brine. The cell feed must contain no calcium, magnesium, or iron compounds because these would form insoluble hydroxides in the cells. Insoluble hydroxides, as well as dirt in the crude salt, would quickly plug the pores of the diaphragm. Within limits the grade of raw salt used depends on the relation between the price of the crude salt and cost of purification.

Crude salt containing 99.3 percent NaCl is received from the Leslie Salt Company, Newark, in gondolas. The salt is dumped into pits and made into a slurry with river water and with caustic-bearing brine returned from a later step in the process. Sodium carbonate is added to the saturated brine thus formed. The mixture is agitated with compressed air in steel tanks where the sodium carbonate and caustic soda cause the calcium, magnesium, and iron compounds to precipitate. These precipitates, together with dirt and organic matter, are removed with a Dorr thickener, washed, and discarded. The acidity of the blear brine is then adjusted by adding hydrochloric acid, and the brine is ready for electrolysis.

Potassium chloride solution is prepared in a similar way except that the solution is prepared hot because the solubility of potassium chloride, unlike that of sodium chloride, increases rapidly with temperature. The raw material is potassium chloride of chemical grade which comes in part from Trona and in part from New Mexico.

The second step is the electrolysis of the brine. In the caustic soda section the Dow cell is used. This is a diaphragm cell developed by the Dow Company and used in most of their installations. In the caustic potash section, the capacity of which is but a fraction of that of the caustic soda section, Allen-Moore cells are used. This is an early type of diaphragm cell that is little used today. These particular cells were part of the original plant built in 1917. The gases from the soda and potash cells are collected in mains under just enough vacuum to prevent leakage into the atmosphere.

The third step comprises the purification and concentration of the cell products. Hydrogen from the soda and potash cells is combined, purified, and used by another department of the Dow Company in the synthesis of ammonia. Chlorine from both groups of cells is also combined for further treatment. It is first cooled and washed by passing it through a series of towers containing water sprays. In a second series of towers it is dried by contact with concentrated sulfuric acid. Finally the purified and dried chlorine is compressed and liquified. Horizontal piston compressors with carbon rings compress the gas to 50 pounds per square inch. Care must be taken to keep oil and grease away from the chlorine. Piston rods operate in chambers filled with compressed air to prevent leakage of chlorine past the glands. The compressed chlorine is liquefied by cooling and is stored in steel tanks. Most of the chlorine is shipped in liquid form.

The cell effluent, which contains 10 percent caustic and also undecomposed chloride is concentrated and purified by evaporation. Both the caustic soda and caustic potash liquors are treated by similar methods. The evaporator house contains triple effect, double effect, and single effect evaporators that can be used in a number of combinations. Equipment that is in contact with the extremely corrosive liquor is made of nickel. Forced-circulation evaporators with external heat exchangers mounted horizontally beneath the flash chambers are used.

In the first step the weak cell effluent is evaporated to 30 percent caustic. At this concentration much of the salt crystallizes and is removed with an Oliver filter, the filter cloth of which is a fine nickel screen. Next the 30 percent liquor is evaporated to 50 percent caustic, and after it is cooled most of the remaining salt crystallizes and is filtered out. Much of the 50 percent liquor is sold without further treatment. Some solid caustic is produced by further evaporation. First the 50 percent liquor is evaporated to 70 percent caustic with steam evaporators. The final evaporation to dryness is done either in large direct-fired cast-iron pots or in a Dowtherm evaporator. The Dowtherm evaporator is a heat exchanger in which an organic liquid of high boiling point is used to attain the temperature required.

The liquid caustic is either poured into drums where it solidifies upon cooling or it is granulated with a flaking machine.

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Mantell, C.L., Industrial electrochemistry, 2d ed., pp. 332-375, New York and London, McGraw-Hill Book Co., 1940.

CALIFORNIA HISTORY SUBJECT OF NEW FILM

"California's Golden Beginning", an 18-minute motion-picture portrayal of California's early history has been acquired by the Division of Mines film library. This film, 16 mm., in color with sound, was made available to the library by the California Centennials Committee.

Other 16 mm. films which are available include:

California and Its Natural Resources (45 minutes, sound, color), a pictorial survey of the natural wealth of California.
Ghost Towns (45 minutes, sound color), the story of California's early mining days. This shows many of the historic buildings and landmarks of the gold-rush period.
Prospecting for Petroleum (23 minutes, sound, color) describes the methods of finding oil, emphasizing geological and geophysical methods.
Birth of an Oil Field (30 minutes, sound, color) shows production and refining methods.
The Last Ten Feet (20 minutes, sound, black and white), the story of what is behind the "last ten feet" of hose in the gasoline pump.

Responsible groups in California wishing to borrow these films may do so at no charge excepting transportation. Bookings should be secured well in advance of the desired date of showing.

CALIFORNIA TOPOGRAPHIC MAPS

The State of California, Department of Public Works, Division of Water Resources, announces that the following topographic maps of areas in California have become available recently:

PUBLISHED FOR GENERAL DISTRIBUTION

Copies may be secured from local distributing agencies or from the U.S. Geological Survey, Denver Federal Center, Denver 15, Colorado, at a cost of 20 cents each.

New Mapping

Location of S.E. Corner Latitude Deg.	Min.	Longitude Deg.	Min.	Name	Scale	Contour Interval in feet
33	22½	117	07½	Temecula	1:24,000	20
38	30	121	15	Carmichael (formerly Mills)	1:24,000	5
39	30	121	45	Nelson	1:24,000	5
39	30	121	52½	Llano Seco (formerly Newhard)	1:24,000	5
39	37½	121	45	Chico (formerly Durham)	1:24,000	5

PHOTO-COMPOSITES

Advance black line ozalid prints of completed maps prepared for final checking and editing. Copies may be secured at a cost of 50 cents each from the Pacific Region Engineer, U.S. Geological Survey, Box 346, Sacramento 2, California.

33	15	117	00	Pala	1:24,000	20
33	22½	117	00	Pechanga	1:24,000	20
33	37½	117	37½	El Toro	1:24,000	20
33	37½	118	00	Seal Beach	1:24,000	5
34	10	114	05	Parker Dam Area	1:62,500	40
35	30	117	15	Searles Lake	1:62,500	40
36	15	119	22½	Goshen	1:24,000	5
36	22½	119	15	Monson	1:24,000	5
36	37½	119	22½	Wahtoke	1:24,000	5-25
38	37½	120	45	Placerville	1:24,000	40
38	45	120	52½	Coloma	1:24,000	40
39	30	121	37½	Shippee	1:24,000	5
39	37½	121	22½	Las Plumas	1:24,000	25

Topographic maps of California are available for consultation (but not for sale) at the Library, State Division of Mines. A complete file of topographic maps of the entire United States for public reference is located in Room 702, U.S. Appraisers Building, Washington and Sansome Streets, San Francisco.

PUBLICATIONS OF THE DIVISION OF MINES

The Counties of California - Bulletin 142

The supply of cloth-bound copies of Bulletin 142, The Counties of California, Mineral Resources and Mineral Production During 1947, compiled by the staff of the Division of Mines, is now exhausted, and only paper-bound copies selling for $1.25 each are now available. Bulletin 142 is the only Division of Mines publication in which all essential features of mineral information, i.e. general geologic features, mineral resources, significant mining activities, and mineral production, are assembled under one cover. The book is divided into three parts. Part I consists of a brief summary of the mineral commodities of the state together with production tables and graphs. Part II, which forms the bulk of the bulletin, takes up each county in alphabetical order and discusses geologic features, mineral resources, significant activities, and mineral production. Part III is a directory of mineral producers, smelters, mineral dealers, custom mills, grinding plants, and testing laboratories.

Economic Mineral Resources and Production of California - Bulletin 130

All remaining copies of Bulletin 130, Economic Mineral Resources and Production of California, by Samuel Dolbear and others, will be sold for $1.00 plus tax. This 365-page book is an exhaustive summary of the commercial minerals of California, arranged alphabetically by commodity, together with statistical tables arranged by commodity, county, and state; significant chapters on mineral reserves, employment in the mineral industry, legislative and other controls, function of minerals in the state's economy, needed changes in laws pertaining to the mineral industries, mineral needs of industry, etc., are included.

Manner of Locating and Holding Mineral Claims in California

Reprints of The Manner of Locating and Holding Mineral Claims in California, by A.H. Ricketts and C.A. Logan, are now available. Copies will be given free of charge to all who purchase one dollar's worth of other publications. Single copies sell for fifty cents each. This booklet is invaluable to all prospectors and claim owners as well as mining firms.

GEM MINERALS

Minerals were used by earliest man for personal adornment, and those which have been especially suited for that purpose have been called gems, gemstones, or precious stones.

The cutting and carving of gems was first carried out in Babylonia several thousand years B.C. Gem mining is the earliest known form of mining, and primitive man recognized about eighteen different gems and decorative stones before any metals were known. Decorative members of the quartz family were known 100,000 to 75,000 years ago. Emeralds were known as early as 2,000 to 1,800 years B.C.; sapphires and rubies were known later, 800 to 600 years B.C. The first important hard-rock mining enterprise on record was that of the turquoise mines on the Sinai Peninsula around 3400 B.C.

The value of a gem mineral depends upon color, transparency, brilliancy or luster, hardness or durability, rarity, and popularity. In addition, the degree of perfection or flawlessness of the individual stone should be added. Each gem should possess as many of these characteristics as possible. Most gem materials lack several desirable characteristics. The diamond possesses most, and if colored, all of them. Of more than a hundred minerals utilized as gems, four have been called precious stones or noble gems. These are the diamond, sapphire, ruby, and emerald. The pearl, which is of organic origin and not a mineral, is sometimes included in this category. Opals were so classified at one time. The other gem minerals are termed semi-precious or ornamental.

The color of the stone is the first characteristic noted, and the early classification of gem materials was by color and degree of transparency. Thus at one time there was no distinction between rubies and the red varieties of spinel and garnet. Color has been the basis for naming semi-precious stones after precious ones. Certain green garnets have been called Uralian emeralds in this manner. Some minerals, such as turquoise, depend almost solely upon color for their appeal. Certain minerals, such as opal and labradorite, display various internal color hues, called a "play of color". Some colors such as red, blue, and green are always popular, while yellow normally is not. The great popularity of the diamond has made some colorless stones popular.

The way in which light is reflected from a mineral's surface, its brilliancy and luster, is a function of the transparency, index of refraction, and dispersion (ability of a mineral to break white light up into colored rays) of the mineral. When light waves pass from air into a denser medium, they are bent or refracted. The degree of refraction for different colors of light varies with the mineral species and hence some "disperse" white light better than others. The high degree of dispersion of the diamond is the important factor in producing the "fire" of the stone.

The durability of gems is largely dependent upon hardness. Since dust, which consists essentially of fine quartz particles, is constantly acting to abrade the gem and destroy its finish, the gem should be harder than quartz. The four noble gems are all decidedly harder than quartz.

Rare materials naturally are highly esteemed, and for this reason some minerals which have many of the other attributes of gems, do not have great appeal because they are too common. Garnet is such a mineral.

The popularity of gems is determined not only by their beauty and other qualities but also by fashion and local influence. Many superstitions which have existed regarding gems have affected their popularity. Thus the bad-luck superstition regarding the opal did much to bring it into disfavor. The wearing of a proper birthstone is supposed to bring luck, and the effectiveness of the various powers attributed to certain varieties of stones is supposed to be enhanced if such stones are also the birthstone of the wearer. Various peoples have named birthstones for each month of the year; those commonly recognized today are as follows: January - garnet, February - amethyst, March - bloodstone or aquamarine, April - diamond, May - emerald, June - pearl, July - ruby, August - carnelian, sard or sardonyx, September - sapphire, October - opal, November - topaz, and December - turquoise.

Gems can occur in almost all types of rocks - igneous, metamorphic, pegmatites, veins, and the placers derived from any of these. In general, gems are heavier than the average rock mineral, so during erosional processes they tend to become concentrated at the outcrop or in some adjacent placer deposit. Some very resistant gems may have gone through more than one cycle of erosion and deposition. The flawed stones tend to be broken up and lost, so that in comparison with the source rocks, the average gem from placers is of better quality.

A normal geological distribution of gems, according to value, would be approximately 60 percent from igneous rocks (mostly due to diamond production from the basic igneous rock, kimberlite), 35 percent from placers, 0.8 percent from pegmatites (with which California is mostly interested), and 4.2 percent from vein deposits and metamorphic rocks.

Gem production in California is irregular and statistics are difficult to compile due to the small, intermittent, and widely-scattered amounts marketed. Between 1900 and 1946 a total of $2,625,407 in gems has been produced. Of this, southern California mines have produced over $2,000,000. The state's production has included diamond, tourmaline, benitoite, kunzite, aquamarine, morganite, topaz, turquoise, garnet, chrysoprase, and some other forms of quartz.

Diamonds have been found in some of the California placer mines. Most of these were found in Butte County, especially in the gold gravels at Cherokee. Inaccurate records indicate that 400 to 500 stones have been found in the state. Some of these were over two carats in weight and of good color, but most of them were small and off color.

Tourmaline, an aluminum borosilicate combined with various metals such as magnesium, lithium, iron, etc., occurs in prismatic crystals of the hexagonal system. Crystals commonly are grooved or striated parallel to their length and usually show a distinctive rounded triangular outline in end veiw. Tourmaline has no true cleavage but fractures subconchoidally to uneven. Hardness varies from 7 to 7.5 and the color varies through black, brown, and various red and green shades. The black variety is a very common mineral and is characteristic of pegmatitic granites and quartz veins in granites. The transparent to translucent green and pink gem varieties contain lithium and occur principally in pegmatites. Some tourmaline is unique in that a single crystal may be zoned in a variety of beautiful colors. The zones may run across the length of the crystal or they may be parallel to the crystal face from the center outward. The pink color is most desired, and that produced from California is considered to be the world's finest.

Kunzite is a pink to lilac-colored variety of spodumene, a lithium aluminum silicate ($LiAl(SiO_3)_2$). The hardness is 6 to 7. Kunzite is monoclinic and occurs in crystals which are normally blade or lath-shaped and deeply striated and grooved. The thickness of the crystal in the direction of maximum color absorbtion is of prime importance as satisfactory depth of color usually is obtained in one optical direction. Cutting is a difficult problem because of the perfect cleavages of kunzite. As in the case of tourmaline, the gem kunzite is found in pegmatites.

The Pala and Mesa Grande districts in San Diego County and the Coahuila district in Riverside County are the principal tourmaline and kunzite-producing areas in the state.

Many varieties of quartz, which is one of the commonest of all minerals, are widely used as semi-precious stones. These vary widely in color, texture, and complexity of form. Quartz crystal and amethyst are utilized as facet-cut stones while most of the other varieties are cabachon cut. Precious opal is an amorphous form of silica. Agate and the related cryptocrystalline quartz minerals are the principal materials cut by a large number of professional and amateur lapidaries throughout the west.

By far the largest percentage of the world's gem production is utilized by the jewelry trade and for other decorative purposes. World production of gems is dominated by South Africa because of the diamond. Other important gem producing areas are Belgian Congo, West Africa, Brazil, Siam, Burma, and Colombia.

Approximately 15 percent, by value, of the gems produced is used in industry. Diamond, as bort, carbonado or ballas, is the chief gem so used, but sapphire and ruby are used as bearings for watches and scientific instruments. Synthetic gems have been used in industry and are also available for gems. The flame-fusion process, developed by Verneuil in 1904, produced boules of ruby, sapphire, and rutile. Whole or split boules are available at prices ranging from $3 to $10 per 100 carats. Synthetic emerald is prepared in California by a secret process which results in a definite crystal instead of a boule.

Practically all cut gems are sold in the metric carat of 200 milligrams, while the rough material, especially in the case of the semi-precious stones, is sold by the gram, ounce, or pound. The value of the various stones is difficult to determine since it depends so much upon the individual specimen and a variable market demand. The diamond is an exception since the market is closely controlled.

Examples of some of the values of California-produced materials are given below. In the case of rough material, it is assumed that it has been cleaned and chipped out to give maximum amount of finished material. These are not exact market prices but merely indication of the price ranges.

Mineral	Rough Material price per gram	Cut Stones wholesale price per carat
Tourmaline		
poorer darker greens	10 to 15 cents	
medium green	65 cents	$3 to $6
fine green and pink	$1 to $5	$8 up to 10 carats – over 10 carats, any price
Kunzite		
light	15 to 20 cents	
fine dark	$3	$4 to $25
Morganite	50 cents to $3	
Garnet		
light (orange)	to yield 5 carats or better $2 to $5	
dark	50 cents	
Topaz		
colorless to blue		$5 to $15
Chrysoprase	up to $40 per pound	

Prices obtained by personal communication with several lapidaries in Los Angeles

MINING AND INDUSTRIAL NEWS NOTES

Butte County Gold Dredge

Good progress is being made in remodeling the Yuba No. 3 dredge of Yuba Consolidated Goldfields, which is located on the Feather River east of Gridley, California. The regular gold saving sluices are being replaced with Yuba Placer jigs. One 6-cell and two 4-cell rougher jigs are installed on each side of the trommel screen and the concentrates from these jigs will be treated further in a 4-cell cleaner jig. The remodeling work started January 16th under the supervision of Grant Leeson. The dredge has been operating in this area since 1940 except for the war period when gold mining was at low ebb. Cecil D. Brophy is dredgemaster and a crew of 14 men is normally employed.

New Gold Operation in Inyo County

Reopening of the Corona Mine (formerly New Discovery and Gem), located 5 airline miles south of Wildrose Station in the Panamint Range, Inyo County, has been initiated by the Corona Mining Company, Trona. Unwatering and rehabilitation of the 220-foot vertical shaft has been completed to the 95-foot depth. The property which has formerly produced gold, was acquired by the company, a mining partnership consisting of Rene Loustalot, John F. Lee, and Fred Rosser, from A.F. Troster. Five men are presently employed under Lee and Rosser.

Yolo County Gas Line

The new 6-inch pipe line from the Dunnigan Hills gas field west of Zamora in Yolo County was connected to the Davis line at the Spreckles Sugar Company plant on February 1st. The line furnishes an outlet for five natural gas wells in the district.

REFERENCE LIST OF RECENT PUBLICATIONS

The references listed below are available for study in the Division of Mines Library, but are not on sale by the Division.

Ferguson, Henry G., and Muller, Siemon W., Structural geology of the Hawthorne and Tonopah quadrangles, Nevada: U.S. Geol. Survey Prof. Paper 216, 55 pp., 15 plates, 10 figs., 1949. A study of the geology of pre-Tertiary rocks and Jurassic diastrophism. Part of the area covered by this report is in California.

Gutenberg, Beno, Richter, C.F., Seismicity of the earth and associated phenomena, 273 pp., 34 il., 19 tables, Princeton Univ. Press, 1949. A discussion of the major earthquakes, earthquake belts, and the causes of earthquakes.

Taylor, Clarion W., and Wilfley, Robert D., Processing of perlite ore: Rock Products, vol. 53, no. 2, pp. 94-96, 143, February 1950. The characteristics of ore in their relation to expansion into lightweight aggregate are considered; also the factors of classification and furnace operation.

Tyler, Paul M., Economic importance of pegmatites: U.S. Bur. Mines Inf. Circ. 7550, 58 pp., February 1950. The geology, mining and milling methods, production, and uses of minerals occurring in pegmatites are discussed.

Wiebelt, Frank J., and Ricker, Spangler, Investigation of the Atolia tungsten mines, San Bernardino County, California: U.S. Bur. Mines Rept. Inv. 4627, 25 pp., February 1950. Contains a short description of the ore deposits (chiefly scheelite). Most of the article consists of the logs of diamond-drill holes.

ACKNOWLEDGMENTS

The Division of Mines gratefully acknowledges the gift of the following volumes to its technical library:

From Mr. Quenton L. Brewer

Mineral Resources of the United States, 1917 to 1925, all nos.; nos. 1-2, 1926; pts. 1-2, 1928, pts. 1-2, 1930.
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Rietz, H.L., and Crathorne, A.R., College algebra, New York, Henry Holt and Company, 1909.
Miscellaneous pamphlets and reprints.

From the Idaho Maryland Mines, courtesy of Mr. E.E. Hampton

Am. Inst. Min. Met. Eng., Bull., nos. 145, 147-153, 155, 1919.

From Baroid Sales Division, National Lead Company

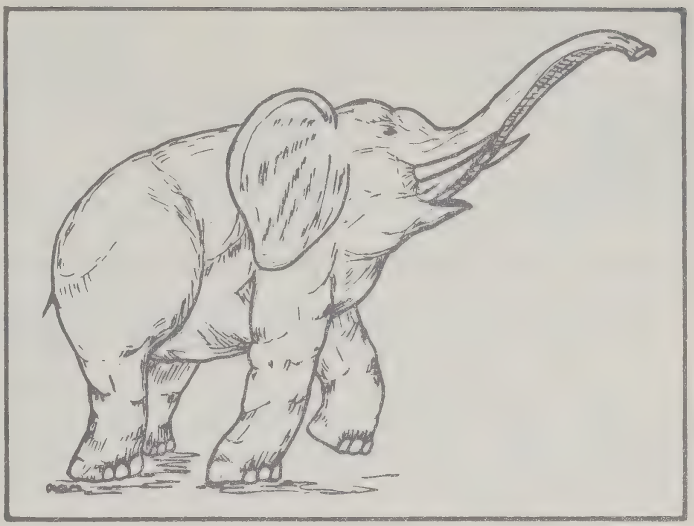
Am. Inst. Min. Met. Eng., Petroleum Tech., vol. 4, no. 6; vol. 5, nos. 1, 2, 4, 5, 6; vol. 6, nos. 3, 4, 6; vol. 7, nos. 1, 3, 4, 5, 6; vol. 8, nos. 1, 2, 4, 5, 6; vol. 9, nos. 2, 3, 5; vol. 10, nos. 1, 4, 5, 6; vol. 11, nos. 1, 3, 4, 6, 1941-1948.

THE ELEPHANT AS THEY SAW IT

"Monday 24th this day some kind of mettle was found in the tail race that looks like goald first discovered by James Martial, the Boss of the Mill.

"Sunday 30th Clear and has been all the last week our metal has been tride and prooves to be goald it is thought to be rich we have picl up more than a hundred dollars woth last week" The Discovery of Gold, as Recorded in the Diary of Henry W. Bigler, January 24, 1848; Extract from "THE ELEPHANT AS THEY SAW IT, A Collection of Contemporary Pictures and Statements on Gold Mining in California".

As a Centennial Supplement to the October 1949 California Journal of Mines and Geology, the Division of Mines has recently published THE ELEPHANT AS THEY SAW IT: A Collection of Contemporary Pictures and Statements on Gold Mining in California.



"This animal stood symbolically for the whole business of gold seeking. When a San Franciscan told a friend that he'd about decided to 'see the elephant', he did not mean that he was going on a toot, but that he intended to take a flier at the mines." Stewart Edward White, Old California, In Picture and Story.

Much has been written, and is being written, about California's fascinating gold-rush period--its romance and adventure, its morals and lack of morals, and its customs and characters; but comparatively little attention has been devoted to the purpose which most emigrants had in mind when they set out for California: the actual mining of gold.

The series of quotations and pictures presented in THE ELEPHANT has been gathered to call attention to this phase of the gold-rush, and as a small tribute to those whose efforts a century ago gave purpose to the Centennial we now celebrate; to those who have seen, and still see, "the elephant": to the gold miners of California.

An attempt has been made to trace the history of gold and gold mining in this state from a time, almost four and a half centuries ago, when the legend of the island of California was first conceived, to the year 1860, when the "elephant" was in his vigorous and youthful prime; this, chiefly through the words and drawings of contemporary writers and artists--those who should best know whereof they speak.

All of the lithographs reproduced in THE ELEPHANT represent methods of gold mining used in California between 1840 and 1860. Some of the drawings have been published several times--as letterheads in the early days, and as illustrations in articles or books. Captions are those that accompanied the pictures on the letterheads or in the publications from which they were obtained.

Comments have been kept to a minimum, and are presented as footnotes supplementing the several quotations.

Quotations and pictures from original writings, letters, and books of several periods, have been collected and arranged under the following headings: FACTS AND FANCIES, 1500-1840; THE GOLD RUSH OF 1842; THE DISCOVERY OF GOLD AT SUTTER'S MILL, AND EARLY DAYS OF THE GOLD RUSH, JANUARY 24, 1848 TO AUGUST 23, 1848; THE MINING OF GOLD, 1849-1860; DAGUERREOTYPES AND AMBROTYPES TAKEN IN THE DIGGINGS.

Copies of THE ELEPHANT AS THEY SAW IT may be obtained for 75¢ each from the Division of Mines.

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INVENTORY OF MINES AND MINERAL RESOURCES OF THE COUNTIES TUOLUMNE, KERN, BUTTE, AND SONOMA

One of the functions of the Division of Mines is to periodically take stock of the mining activities and mineral resources of the various counties of the state. Within the past year and a half, four county reports have been published, on TUOLUMNE, KERN, BUTTE, AND SONOMA; these appear in the January, April, and July 1949 issues, and the January 1950 issue of the California Journal of Mines and Geology, and are now available to the public.

Olaf P. Jenkins, Chief
State Division of Mines
Ferry Building
San Francisco 11, California

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MINERAL INFORMATION SERVICE

Vol. 3 May 1, 1950 No. 5

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

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IN MEMORIAM

WALTER W. BRADLEY

Walter Wadsworth Bradley, retired State Mineralogist, passed away suddenly Tuesday, April 11, as the result of a heart attack. Mr. Bradley was associated with the Division from 1912 to 1946, acting as its Chief from 1928 to 1946. Prior to his association with the Division of Mines, Mr. Bradley had practiced mining engineering in the Mother Lode, in Durango, Mexico, and in Idaho. In addition, he was associate editor with T.A. Richard on the staff of the Mining and Scientific Press.

He was graduated with the advanced degree of Mining Engineer from the University of California in 1917, having left an enviable scholastic record. Published works by Mr. Bradley covered a wide variety of subjects including ore-dressing, quicksilver resources, manganese, magnesite, and chromium, as well as numerous reports on California mines and mining districts. His works are well known to nearly all readers of California mining and geological literature. In addition to his professional interests Mr. Bradley was active in numerous East Bay and San Francisco service, choral, historical, and recreational organizations.

Mr. Bradley's sudden passing was a shock to the present staff of the Division of Mines, many members of which were closely associated with him for many years both socially and professionally. He will be remembered as a kindly, congenial gentleman who always retained his interest in mining and geology and in the Division of Mines to which he had devoted most of his life.

POST-WAR DEVELOPMENTS AND CONDITIONS IN THE CALIFORNIA CEMENT INDUSTRY

Cement production is one of the most important mineral industries in California. In value of annual output it exceeds any other solid mineral product. California ranks second nationally in cement production, and far exceeds every other state in cement consumption. In 1948, California's cement plants produced 24 million barrels of all types of cement to establish a new record exceeding the previous high of 23 million barrels produced in the war year of 1942. After 1942,production declined to 14.5 million barrels by 1944. The 1948 record represents the culmination of a steady increase in production since 1944, motivated by the strong post-war demands of the building industry. At present, 11 cement plants are operating in California, 6 in the southern and 5 in the northern part of the state. One of the southern California plants buys clinker; the others calcine their own raw materials.

Since World War II the California cement industry has been geared to supply an unprecedented peacetime demand for cement of all types. Local shortages actually developed in southern California during 1948; however, shortages of cement were less than for most other building materials. To meet demands the industry has had the choice of increasing capacity by enlarging and modernizing the present plants or by building new plants. Being acutely aware of the danger of over-expansion during what may be a temporary period of high demand, cement companies have restricted their building activities to improvement of existing plants. Cement companies have been reluctant to establish new plants because of high construction costs, which are two to three times as high as they were ten years ago. A rise of only 45 percent in cement prices during the same period does not justify new construction. Remodeling old plants to increase efficiency and output costs $2.00 to $4.00 per barrel of annual capacity compared to about $6.00 per barrel of annual capacity for new plant construction. Despite prohibitive construction costs, cement companies may be forced in the near future to seek new plant locations because of raw material deficiencies and raw material transportation problems.

Cement plants have experienced rising production costs for several years, parallel to the general cost-rise in all industries, owing to the increased cost of labor, power, fuel, and equipment. In addition to these, some cement plants have raw-material problems which include increased cost of mining at present sites because of depletion of easily accessible portions of limestone and clay bodies, and the presence of excessive amounts of undesirable silica, magnesia, and alkalies in the limestone. The latter problem requires "sweetening" by better material not available near the plant or beneficiation of the available material. Rising freight rates have tended to shrink the marketing area of cement plants. Distribution problems were further aggravated by a Supreme Court decision which limits freight absorption practices used by cement companies. For several years cement companies had quoted delivered prices for their products, which resulted in a uniform price for all brands of cement sold in a given area. In this system part of the freight charges were paid by some of the cement companies. If competition among cement companies should become intensified, in the face of slackening cement demand, plants farthest from consuming areas would be the first forced to curtail output. Plants located closest to large markets might subsequently be enlarged.

The freight absorption controversy became actively detrimental to the cement industry with the Supreme Court decision in the "cement case", which declared such practices to be illegal because they tended to create monopolies and fix prices. A bill which is pending in Congress, but which has not yet become a law, provides that a seller acting independently may absorb freight "except where such absorption of freight would be such that its effect upon competition would be to substantially lessen competition".

To offset rising production costs and to increase capacity, California plants have undergone many improvements. Substantial labor savings have been made in mining and handling raw materials by increased mechanization and by replacing worn and obsolete equipment. Fuel savings in the range of 10 to 15 percent have been effected through the installation of longer and more efficient kilns and the use of better instruments to control kiln conditions more carefully. The use of Lepol system kilns at the Santa Cruz Portland Cement Company at Davenport, Santa Cruz County has resulted in what appears to be the best fuel economy in the United States. These kilns have achieved a consumption of 704,000 Btu per barrel of clinker. In the Lepol system the dry raw-ground material is fed into a rotary nodulizer where it is moistened and rolled into small nodules. The nodules, one-half to one inch in diameter, are spread to a depth of 6 inches on a travelling grate. Here they are dried and then partly calcined by hot kiln gases that are drawn downward through the bed and grate. The grate discharges the nodules into a kiln of standard design usually from 110 to 125 feet long and 10 or 11 feet in diameter. The operation of these Lepol-system kilns requires more instruments than are required on most conventional rotary kilns. Fuel economies are being achieved in other plants by the installation of longer kilns. The Riverside Cement Company has installed 3 new kilns 350 feet long at its Oro Grande plant in San Bernardino County in addition to revamping most of the plant. These are the world's longest dry process kilns. Wet process kilns consume more heat than the dry process but economies have been made by installing better slurry drying equipment, more efficient heat-recovery units and using longer kilns. The Permanente Cement Company has 4 wet process kilns 465 feet long, the world's longest.

Several plants have increased capacity by balancing the output from various units of the plant. For example, at Permanente the finish-grinding plant had greater capacity than other units of the plant. Kiln capacity was increased ten percent to equal the capacity of the finish grinding unit by the installation of new clinker coolers. The raw grinding capacity was increased in three ways: (1) crushing the limestone to smaller size, (2) using old clay-grinding mills in open circuit grinding of limestone and (3) by feeding raw limestone into the primary mill classifier rather than directly into the mill.

Southwestern Portland Cement Company at Victorville has recently increased its production by adding a new kiln.

Cement is shipped from California plants by rail, truck, and ship, both bulk and sacked. The portion of cement shipped in bulk has steadily increased since before the World War II. Bulk shipments now constitute about 65 percent of all cement shipments. Bulk cement is transported in hopper trucks and trailers, in specially constructed ships, and by rail in bottom-dump hopper cars or bulkheaded boxcars. Several California plants have bulk cement depots in ports on the Pacific coast and in Hawaii, which they supply by ship. Truck transportation has greatly increased, particularly on short hauls where the advantage over rail transportation is greatest. Most sacked cement is shipped on flat-bed trucks or in boxcars. However, during World War II large quantities of sacked cement were shipped overseas for use in military installations.

A small tariff of 8.55 cents per barrel of cement is levied against imported cement. Although foreign cement carried as ballast could be sold profitably in some United States coastal area, it is believed that none will be imported into California. Furthermore, California exports about 3.5 million barrels annually to other states and countries.

Cement plants are located near suitable deposits of limestone and argillaceous material - clay, shale, or slate (at one plant mud containing calcareous shells dredged from San Francisco Bay is used). The deposits closest to consuming areas are the most desirable. The best locations that satisfy these requirements in California have been occupied. Many deposits of suitable limestone and shale exist in California but remain unexploited because of their distance from consuming areas. These deposits represent reserves that will be utilized in the future when the better-located deposits are depleted. In general the smaller the plant the greater the cost of producing a barrel of cement.

as cost of production increases the area in which the cement can profitably be marketed in competition with cement from other plants decreases. At present, cement prices in large California consuming areas are in the range $2.70-$3.30 per barrel bulk.

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FLUORITE

Fluorite or fluorspar is calcium fluoride (CaF_2) and if pure consists theoretically of 51.1 percent calcium and 48.9 percent fluorine. Bodies of fluorspar commonly contain such impurities as silica (SiO_2), alumina (Al_2O_3), calcite ($CaCO_3$), and oxides of iron; only rarely is a body of fluorspar found that will analyze more than 99 percent CaF_2.

Fluorite crystallizes in the isometric system, usually in the form of cubes, but occasionally as octahedrons or dodecahedrons; it usually has good octahedral cleavage. The mineral is number 4 on Moh's scale of hardness and has a specific gravity of 3.01 to to 3.25. Color is variable, not only from one specimen to another, but within a single crystal. The most predominant shades are green, purple, blue, white, and yellow. Specimens may also be colorless.

Fluorite is the name most commonly found in works on mineralogy and is apparently more or less confined by common usage to the pure minerals. Fluorspar, on the other hand is the term used almost exclusively in commercial practice. Many miners call fluorite "spar", but this is to be avoided as it may be confused with feldspar, barite, calcite, gypsum, or even quartz.

In California, fluorite has been reported from 12 counties and small production has been recorded from Riverside and San Bernardino Counties. At the present time no property is producing, but development work is being done on several claims at Clark Mountain, San Bernardino County, and production may be expected in the near future, providing the ore bodies are large and problems of beneficiation can be coped with successfully.

Occurrence

Fluorite is one of two commercially important fluorine-bearing minerals. For all practical purposes it may be considered to be the only one because the other is cryolite, a sodium aluminum fluoride (Na_3AlF_6), the only commercial deposit of which is at Ivigtut, Greenland.

Although fluorite is found in a variety of geologic settings, almost all commercially important deposits are associated with faults or fault zones. The mineral may be present as a simple filling of fault fissures, as a replacement of favorable sedimentary strata adjacent to faults, as a filling of solution cavities near faults, or as a residual deposit resulting from the weathering of one of the first three types. As fluorite is introduced by emanations or hydrothermal solutions, a connected series of openings such as a fault system is a necessary condition in the formation of an economic deposit.

Uses

The uses of fluorite are many and varied and new applications are being developed regularly. The steel industry is at present the largest single consumer of fluorite; second, is the hydrofluoric acid industry, and third is the glass industry. These three industries annually consume about 90 percent of all fluorite produced. Additional small quantities are used in the production of enamel, iron, ferro-alloys, primary aluminum and magnesium, cement, and welding rod. Because of many recently developed uses of hydrofluoric acid, including its use in an entirely new field of petroleum chemistry, it is to be expected that the quantity of fluorspar consumed in producing this chemical will steadily increase. Although fluorspar may be replaced by other raw materials in some of its present uses, it is very probable that new applications being discovered will exceed those being superceded and that the demand for fluorspar will increase rather than decrease.

The advantage of using fluorspar in the production of steel or in other metallurgical processes is dependent upon its low melting point (1270 to 1387° C.); upon its low viscosity when molten; and upon its adaptability to forming eutectics so as to flux silica, calcium and barium sulfates, alumina, and other materials which are highly refractory.

The formation of these eutectics results in an easily fusible and very fluid slag which is highly desirable. Fluorspar also tends to either volatize or form a slag with phosphorus, sulfur, and other unwanted impurities in iron and other metals.

In the production of hydrofluoric acid, finely-ground fluorspar is treated with sulfuric acid, producing hydrofluoric acid and calcium sulfate. The hydrofluoric acid is distilled off as a vapor and collected in water in lead-lined containers. Once produced, the acid is used for etching glass and in the manufacture of fluorine chemicals. A recently developed use for hydrofluoric acid is in the production of fluorine-chlorine gases known as Freon which are used as household and commercial refrigerants. Another new use is in the so-called alkylation process of manufacturing 100 octane gasoline. This process opens up an entirely new field of fluorine chemistry which is dependent on a large and steady production of fluorspar.

The glass industry consumes large amounts of fluorspar in the production of opal or opaque white glass and colored or cathedral glass. Small quantities of fluorspar are used in the manufacture of enamels in which the fluorspar serves as a flux and a secondary opacifying agent. The value of fluorspar in its applications to glass manufacture is dependent upon its ability to promote the crystallization of fluorides in the glass giving it a milky or opalescent effect.

Beneficiation

Fluorspar of shipping grade is encountered only in a very few mines. Most ore must be concentrated to bring it up to the buyer's specifications. The methods used to concentrate the ore depend upon the type and physical characteristics of the impurities present. Minerals such as barite, galena, sphalerite, pyrite, all other sulfides and sulfates, all other lead and zinc minerals, and all iron compounds are considered to be definitely harmful in the processes to which fluorspar is applied. Therefore, these minerals must be entirely removed. Diluents, or materials which have no detrimental effects in the uses of fluorspar, are calcite or any form of calcium carbonate, silica in any form, silicates and alumina-silicates, granite, slate, shale, sandstone, sand, clay, and other types of wall rock. Although these materials have no harmful effects, they nevertheless require fluxing just as the gangue of the ore being treated, and penalties are imposed for their presence. The penalty for the common impurity silica is calculated by the formula (percentage fluorspar - 2.5 times the percentage silica = the effective fluorspar content). Assuming a concentrate containing 94 percent fluorspar and 6 percent silica, the effective fluorspar content would be 94 - (2.5 X 6) = 79.

Beneficiation of fluorspar ore may be simple or complex depending upon the nature of the ore and the intimacy of association of ore and gangue. In certain residual ores a wholly satisfactory concentrate can be produced by washing alone. More complex ores may be concentrated by screening, tabling, or jigging, and very complex ores may require concentration by flotation or electrostatic separation.

Grade of Ore and Markets

Fluorspar ores are marketed in one of three grades - acid, ceramic, or metallurgical. Specifications for the various grades vary somewhat depending upon supply and demand, but commonly accepted standards are as follows. Acid grade fluorspar requires a minimum of 98 percent CaF_2 and a maximum of 1 percent silica. Ceramic grade fluorspar requires a minimum of 96 percent CaF_2 and a maximum of 2.5 percent silica. Metallurgical grade fluorspar requires a minimum of 85 percent CaF_2 and a maximum of 5 percent silica.

Current prices have prevailed for some time and are - for metallurgical grade fluorspar, per short ton, f.o.b. shipping points in Kentucky and Illinois, $37.00, 70 percent effective CaF_2 content; $34.00, less than 60 percent effective CaF_2 content; and $30.00, pellets of 60 percent effective CaF_2 content. Acid grade fluorspar concentrates, base price, per ton, bulk, 97 percent effective CaF_2 content, $43.50.

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Ladoo, R.B., Fluorspar, its mining, milling, and utilization, with a chapter on cryolite: U.S. Bur. Mines Bull. 244, 1927.
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MINING AND INDUSTRIAL NEWS NOTES

Pumice Building Blocks at Sacramento

Manufacturers of pumice building-blocks in the Sacramento area purchase pumice from deposits in the Glass Mountain district of Modoc County, California, and the Bend and Chemult districts of Oregon. The pumice is white to gray in color and is highly vesicular, weighing only 1050 to 1150 pounds per cubic yard. It is composed of about 69 percent silica, 15 percent alumina, 5 percent sodium oxide, and 2 percent each of potash, lime, and water. Iron oxides amount to 2.75 percent, and minor amounts of other minerals are present. A small amount of black volcanic glass is usually present. The manufacturers purchase the pumice in carload lots from deposits having satisfactory grades. The only specifications are that the pumice shall be clean, pit-run material crushed to minus one-quarter or three-eights-inch sizes. None of the plants screen or size the pumice before mixing, but a small amount of sand is added if the aggregate seems to need more fines. The aggregate is shoveled from the stock pile into the mixers, and the blocks are made in the standard shapes and sizes in vibrating block machines.

The following companies have been manufacturing pumice blocks in the Sacramento area recently: Hokanson Building Blocks, Power Inn Road; Sacramento Building Block Company, 5621 Franklin Blvd.; Sacramento Pumice Brick and Tile Company, 2731 Stockton Blvd.; Volcolite Products Company, 3020 V Street.

These companies use about 3,600 tons of pumice per year in manufacturing lightweight building blocks.

Carbon Dioxide in Mendocino County

Carbon dioxide is being produced from a limestone formation at a depth of 790 feet in the latest well drilled by the Cal. Dri Ice Company near Hopland. The diameter of the new well varies from 12 inches in diameter at the surface to 8 inches at the bottom of the hole. It was drilled with rotary drill, and casing was used for the total distance. A cement water shut-off was placed at a depth of 200 feet. The water issuing from the well with the carbon dioxide has the temperature of 185 degrees Fahrenheit according to Henry De Lotty, general manager of the company. The new well has increased the capacity of the plant to 21,600 pounds of dry ice per day.

Lignite Processing in Amador County

Production of montan wax from lignite mined near Ione, Amador County, recently has been substantially increased. The extraction plant of American Lignite Products Company, Division of the De Angelis Coal Company, was damaged by fire late in 1949, but has been rebuilt and enlarged to several times its previous capacity. Lignite from the Ione formation is treated with solvents, and the extracted montan wax has nearly the same chemical and physical characteristics as carnauba wax. It is used for the same purposes as carnauba wax, namely, in floor polish, carbon paper, shoe polish, and waterproofing material. The American Lignite Products Company is the only producer of montan wax in the United States, Germany furnishing the only other source currently supplying U.S. industry.

CALIFORNIA TOPOGRAPHIC MAPS

The State of California, Department of Public Works, Division of Water Resources announces the following topographic maps of areas in California have become available recently:

PUBLISHED FOR GENERAL DISTRIBUTION

Copies may be secured from local distributing agencies or from the U.S. Geological Survey, Denver Federal Center, Denver 15, Colorado, at a cost of 20 cents each.

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38	37½	120	52½	Shingle Springs	1:24,000	20
38	45	120	45	Garden Valley	1:24,000	40
38	52½	120	52½	Greenwood	1:24,000	40
39	00	121	00	Lake Combie	1:24,000	20
39	00	121	07½	Wolf	1:24,000	20
39	22½	121	17½	Challenge	1:24,000	25
39	30	121	15	Forbestown	1:24,000	25
39	37½	122	00	Hamilton City	1:24,000	5

REFERENCE LIST OF RECENT PUBUBLICATIONS

The references listed below are available for study in the Division of Mines Library, but are not on sale by the Division.

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CALIFORNIA SANDBLASTING MATERIALS

Sandblasting is an important time-saving method of de-scaling metal castings and of removing old paint and rust from surfaces that are to be repainted. This method is commonly employed for cleaning stonework on buildings and for etching glass, stone, and wooden objects. In California, the ship-building and ship-repairing industry consumes the bulk of the blast sand produced in the state. Estimated annual utilization of natural blasting abrasives in California, principally sand and crushed rock, is about 100,000 tons.

Sandblasting materials are of two general types - natural and artificial. The chief artificial materials in current use are steel shot and crushed slag. Steel shot is a high-quality type of blasting abrasive but has a high initial cost. It is generally used in some process where it can be recovered and re-used. Most foundries use steel shot exclusively as a blasting material, partly because of the durability of the steel, but mainly because its use eliminates the danger to the operator of silicosis. Some crushed slags make good blasting abrasives, but most are too brittle and too light-weight.

Natural blasting materials include beach and river sands and crushed rock. Most natural blasting material used in California consists of sand derived from beach deposits. Crushed rock makes good sandblasting material for certain purposes, but has a high initial cost. Tough, hard rocks, such as lava and quartzite, are used to a limited extent. Crushed garnet is particularly good as it combines hardness with a higher than average specific gravity.

Certain measurable physical characteristics of blast-sand control its effectiveness. These are hardness, specific gravity, toughness or compressive strength, angularity, and assortment of grain size. A sand ideal for one sandblasting job may be unsuitable for another, and although a choice of materials can be guided by testing the physical properties of the sand, the final selection should be made by a performance test using sand-blasting equipment. A blasting abrasive suitable for removal of paint from steel or stone would not necessarily be good for removing varnish from a piece of furniture. The texture of the finished surface is important and the amount of dust produced during sandblasting must also be considered.

It is at once apparent that any blast sand should be harder than the material it is abrading. For efficient removal of paint and rust from a metal surface, the abrasive should be harder than both paint and metal. The components of such a blasting material should have a hardness of six or more on the Moh scale. Quartz, feldspar, and garnet, the three most common natural components of blast-sand, have respective hardness of 7, 6, and 7.5 on Moh's scale.

The striking force of a particle is directly proportional to its mass multiplied by the speed of the particle. Consequently, a grain with high specific gravity will strike harder than one of equal size and a lower specific gravity. Common silica-sand abrasive has a specific gravity of about 2.65; crushed garnet, on the other hand, ranges in gravity from 3.5 to 4.1.

A sand grain which shatters on impact will not perform as well as one which holds together. Moreover, the shattered grains cannot be used again effectively, and much objectionable dust is formed. Some United States Navy specifications for blasting sand used in Navy shipyards call for a minimum compressive strength of 60,000 pounds per square inch. The compressive strength of minerals and rocks is not uniform for one species, and each occurrence must be tested separately.

Experiments by the Canadian Department of Mines have shown that angular sandblasting sands cut at a faster rate than rounded grains. Moreover, when cleaning steel, angular grains produce a surface covered with minute scratches that provide an excellent base for adherence of new paint. Rounded grains, on the other hand, tend to produce a ripple-marked surface which is less suitable for painting. Angular grains create more dust than rounded grains of the same material, but their other advantages more than offset this disadvantage.

The screen analysis of sandblasting material is important, and is usually specified when sand is purchased. The proper relation between large and small grains result not only in an even flow of sand through the blasting nozzle but in a more thorough cleaning of the surface. The large grains remove the bulk of the paint and rust, but the small grains are needed to clean out crevices and pits on the surface. The following screen analyses, taken from United States Navy specifications are typical of sands used for removing paint from steel plates:

No. 0

Increment passing 24 mesh	100 percent
Increment accumulatively retained on 30 mesh	0-4 percent
Increment accumulatively retained on 50 mesh	65-85 percent
Increment accumulatively retained on 100 mesh	98-100 percent

No. 4

Increment passing a 4 mesh	100 percent
Increment accumulatively retained on 6 mesh	0-4 percent
Increment accumulatively retained on 8 mesh	40-60 percent
Increment accumulatively retained on 14 mesh	90-100 percent
Increment accumulatively retained on 20 mesh	remainder

Beach sand is the most plentiful and economical blasting material available in California, and consequently it is the most widely used. Many small contractors use unprocessed beach sand from the source nearest their job. Such sand usually contains miscellaneous debris, such as bits of wood, shell fragments, shale, and various organic particles. It is not very efficient and usually causes a great deal of dirt and dust. However, on a small job where the abrasive is not recovered, the use of such material may be economically sound.

Tides and currents in the vicinity of Monterey Bay have been and still are favorable to deposition of large tonnages of sand suitable for blasting. Some of this sand has been classified by the wind into dune deposits of uniform grade. It has been estimated by men in the industry that 70 percent or more of the sandblasting material produced in California comes from the Monterey Bay area. Several companies operating in this area are recovering both beach and dune sand, some of which is used for a blasting material. In the vicinity of Seaside, north of the town of Monterey, two draglines are removing sand from the surf. The sand consists of subangular to subrounded grains of quartz and feldspar with minor amounts of chert, quartzite, and ferro-magnesian minerals. There is a wide range of grain size with an increase in angularity and quartz percentage in the smaller sizes. These draglines consist of a deadman about 50 feet out in the surf, a bucket line, and power house. The sand is dragged upon the beach and removed as it is needed. The Pacific Coast Aggregates, Inc., the operators of one of these draglines, market some sand directly from this location, and send some of it to their processing plant in Oakland. The Monterey Sand Company, which runs the other dragline, has a sand processing plant at Seaside. Here the sand is washed in fresh water, dried, and then screened into nine different grades and one reject ($+\frac{1}{4}$ inch). The sand is then mixed to specifications by allowing the different grades to feed onto a moving belt. The finished product is then either sacked or shipped in bulk

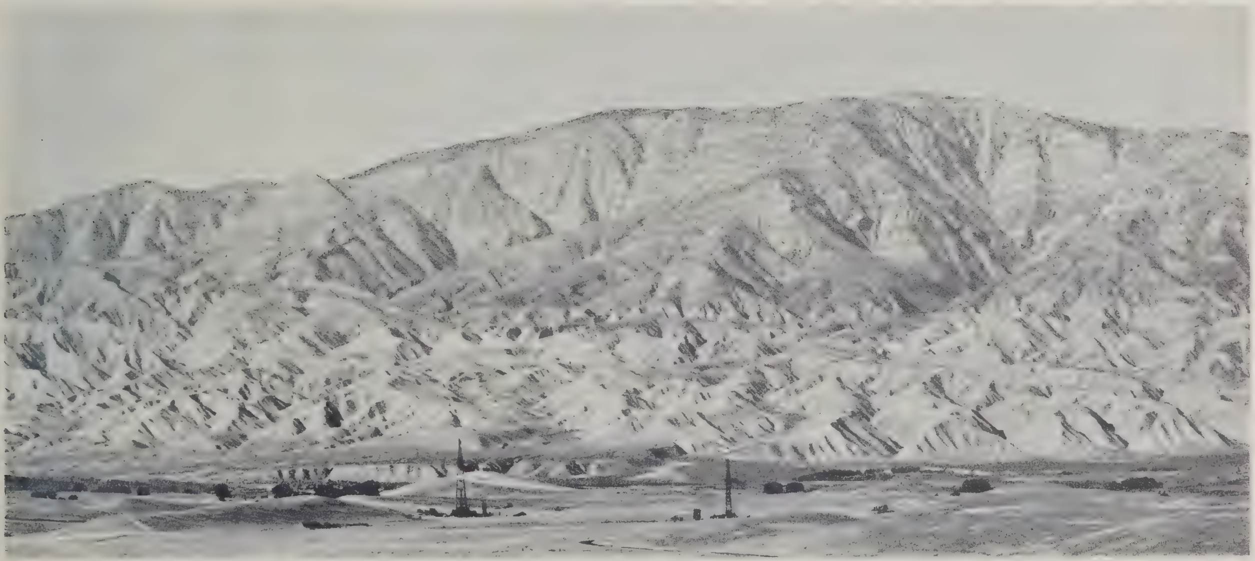
South of Monterey are extensive dune and beach deposits of the Del Monte Sand Company and the Owens Illinois Glass Company. Although the bulk of this sand is used for other purposes, the oversize is marketed principally as sandblasting sand. This product is more angular, and has a higher quartz content than sand from the Seaside area, but is not coarse enough for use in the shipyards. It is used principally in metal-working ships, and on dams and bridges.

Near El Segundo, Los Angeles County, a large amount of feldspathic dune sand has been deposited along the coast line. This sand is excavated by power shovel and supplied to the local markets for abrasive sand and for other purposes. The Minnesota Mining and Manufacturing Company operates a quarry near Corona, California, where hard dacite porphyry is quarried to be used in the manufacture of granules. Some of these granules are marketed as a blasting material, although the bulk of them are used in other ways. This is a hard, tough material which makes an excellent blasting sand.

In San Diego County, blasting sand is produced by the Crystal Silica Sand Company, at their deposit near Oceanside. This material, a poorly consolidated sandstone, consisting primarily of quartz and feldspar, is stripped and brought directly to a washing and screening plant. The bulk of this sand is marketed for other purposes than sandblasting.

Since 1938, Huntley Mineral Products of Bishop, California, has produced annually small amounts of abrasive garnet from the Pine Creek tungsten mill tailing. This product is marketed as a blast sand, and has been used principally by the aircraft industry.

Recently, slag from the old Copperopolis copper smelter has been utilized as blasting sand. In contrast to most slags, this material seems to be tough and compact, and San Francisco Bay area shipyards that have sampled it report that it has excellent cutting qualities. As it contains about 25 percent chemically combined iron it is rather heavy, having an average specific gravity of 3.5. This material is removed from the slag dump by blasting, and is then crushed to size on rolls.



Russell Ranch oil field in August 1948, looking northeast at Caliente Mountain; Cuyama River at the base of the range. Prominent white beds of the Vaqueros formation in the upper part of the range are thrust toward the observer over the near-vertical Monterey strata exposed in the light-colored foothills. Trace of the thrust fault crosses the photograph approximately at the break in slope at the top of the low foothills. Photo by Spence Air Photos through the courtesy of Richfield Oil Corporation.

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
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BULLETIN 149, GEOLOGY AND MINERAL DEPOSITS OF AN AREA NORTH OF SAN FRANCISCO BAY, CALIFORNIA, BY CHARLES E. WEAVER

The area covered by bulletin 149 includes the Vacaville, Antioch, Mount Vaca, Carquinez, Mare Island, Sonoma, Santa Rosa, Petaluma, and Point Reyes quadrangles. It is a revision and condensation of a longer scientific treatise prepared by Dr. Weaver for publication by the Geological Society of America. It also includes a chapter on the commercial mineral deposits found in the area, prepared by William E. Ver Planck, Jr., of the Division of Mines.

Bulletin 149 represents one of the series of quadrangle reports which the Division has been publishing. It contains a comprehensive report on the descriptive geology of the area covering the Sur series, Franciscan group, Upper Jurassic and Cretaceous, Tertiary formations, Quaternary formations, and igneous rocks. It includes a section on structure.

As the district described is in close proximity to the industrial and market areas in the San Francisco Bay region, it is of particular importance that a section on economic geology be included. The following minerals are described: asbestos, clay, coal, diatomaceous earth, gold and silver, graphite, limestone, magnesite, building stone, travertine, and other structural materials. The occurrence of ground water is also described, in its relation to the general geologic features.

There are, in addition to the descriptive material on geology and mineral deposits, 4 pages of photographs, and various index maps. Twenty plates are folded in a separate box which accompanies the report. These include a series of colored geologic maps, scale 1:62500, which have been printed on the standard U.S. Geological Survey topographic quadrangles; a series of economic maps showing location of mineral deposits; geologic structure sections; and a generalized stratigraphic section.

This book (cloth-bound), including the box of maps, may be purchased for $4.00. California residents please add 3% sales tax to their remittance.

Olaf P. Jenkins, Chief
State Division of Mines
Ferry Building
San Francisco 11, California

Date ____________________

Please send me:

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MINERAL INFORMATION SERVICE

Vol. 3 June 1, 1950 No. 6

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

MINERAL DISPLAY AT REDDING

The Division of Mines is happy to announce that it has been loaned the mineral collection of Dr. George A. Grotefend of Redding. The collection includes many fine specimens which were assembled by Dr. Grotefend over a long period of time. Numerous specimens were taken from mines in the Redding district and will be of particular interest to local people.

The collection is on display in the lobby of the Division of Forestry Building on Cypress Street where the Division of Mines now has its office.

TUNGSTEN

Tungsten is one of the major alloying elements used in steel manufacturing. Another very important use is for filaments in incandescent electric lamps and radio tubes.

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Tungsten never occurs free in nature and is found in relatively few minerals. Of the fourteen known tungsten-bearing minerals, the only four of commercial importance are ferberite, $FeWO_4$; wolframite, $(Fe,Mn)WO_4$; hübnerite, $MnWO_4$; and scheelite, $CaWO_4$. In each of these tungsten is the principal constituent. Scheelite and wolframite are the world's most important tungsten ore minerals. Ferberite is the principal tungsten mineral in Colorado's most productive deposits. Hübnerite is seldom found in commercial ore bodies. The United States is unique in that it alone of the tungsten-producing countries produces more scheelite and ferberite than wolframite.

Scheelite, calcium tungstate ($CaWO_4$), contains 80.6 percent WO_3 when pure and is the principal tungsten ore mineral in California. The mineral is white, yellowish-white, or else colored in light shades of yellow, brown, green, and red. The streak is white, and freshly broken surfaces show a characteristic greasy luster. Other characteristics are: hardness, 4.5 to 5; specific gravity, 5.9 to 6.1; tenacity, brittle; cleavage, perfect; and fracture, uneven. Crystallizing in the tetragonal system, its habit is octahedral and tabular; it can also occur in reniform masses with columnar structure and in granular massive forms. Scheelite is characterized by its bright, light-blue fluorescence under ultra-violet light. The use of the ultra-violet lamp for recognition of scheelite is common as an aid in ore grade control and to check mill efficiency.

Ferberite, wolframite, and hübnerite form an isomorphous series between iron tungstate and manganese tungstate and are generally termed the wolframites. These are all heavy (sp. gr. from 7.2 to 7.5) and have a hardness of about 5. They range in color and streak from black to reddish brown. All have a sub-metallic luster.

They have perfect cleavage in one direction and uneven fracture. Their crystal system is monoclinic, and bladed or lamellar cleavage masses are common. None of these minerals fluoresce under ultra-violet light.

The presence of tungsten in a mineral can be determined by the formation of a lemon-yellow residue when the powdered mineral is placed in concentrated hydrochloric acid and boiled. The residue thus formed can be subjected to two distinctive tests: 1) it is soluble in ammonia; 2) tin or zinc added to the above residue in hydrochloric acid solution will turn the residue a deep blue color.

Tungsten deposits have been formed under widely different conditions of temperature and pressure, but they characteristically occur in or near the more acid igneous rocks. Most of the commercial primary occurrences are in veins or replacement bodies which are near igneous intrusions. Because of the high specific gravity of the important tungsten minerals and their resistance to weathering, they are readily concentrated in placer deposits. Thus the wolframite placers of China have been the world's principal source of tungsten.

Vein tungsten deposits are normally quartz-rich and commonly contain both scheelite and wolframite, but the important deposits at Atolia, San Bernardino County, contain scheelite as the only tungsten mineral. These Atolia veins are narrow and roughly parallel and occur in an area about 2 miles long and 500 feet wide. The ore was deposited in open fissures and is classified as epithermal. The Atolia veins, which contain the largest bodies of high-grade scheelite known in the United States, are the source of the scheelite in the nearby placer deposits. One of these placer deposits is known as the Spud Patch.

The Bishop district, Inyo County, is one of the few areas of the world where scheelite occurs in commercial quantities in contact metamorphic deposits. The Pine Creek mine, west of Bishop, contains the largest reserve of tungsten ore in the United States and also produces molybdenum, copper, silver, and gold. It has been the state's principal tungsten producer in recent years. The ore bodies are in a garnet-diopside tactite zone between granite and marble. Scheelite is the only tungsten mineral.

California contains more tungsten occurrences than any other state, with the possible exception of Nevada. In addition to Inyo and San Bernardino Counties, small tungsten production has come from Fresno, Kern, Mono, and Tulare Counties.

Since 1905, tungsten deposits in California have yielded a total of nearly 40,000 short tons of 60 percent WO_3 concentrates. This represents nearly one-third of the total United States production. In 1948, California mines shipped 1767 short tons of concentrates, which was 44.1 percent of the nation's total of 4005 tons. Nevada and North Carolina followed California in that order. Domestic production of tungsten has averaged about 40 percent of the total domestic requirements. China, Korea, Brazil and Bolivia are major world producers.

The milling of tungsten ore is complicated by the sliming of the naturally brittle tungsten minerals. Flotation in addition to gravity concentration aids recovery but does not eliminate the slime losses completely.

Tungsten concentrates are chemically treated to produce sodium tungstate, tungstic acid, tungstic oxide, or ammonium paratungstate. These can be reduced to tungsten powder by either carbon or hydrogen in a controlled hydrogen atmosphere at temperatures from 1300° F. to 1900° F. Ferrotungsten can be prepared from the powder by a thermite-reaction process. Either ferrotungsten or the powder can be used in the manufacture of alloy steels. Because of its high melting point, tungsten is never melted during processing. The powder-metallurgy techniques were developed to produce tungsten in a usable form.

Tungsten is used principally in the manufacture of the "high-speed" steels. These steels retain their hardness even at red heat and are particularly useful for metal-cutting tools. The common alloy is the "18-4-1" type, which contains 18 percent tungsten, 4 percent chromium, and 1 percent vanadium, plus 0.65 to 0.75 percent carbon. In addition to cutting tools, other products made from tungsten steels include hacksaw, razor, and knife blades, armor plate, armor-piercing projectiles, and drawing-dies for wire manufacture.

Tungsten is used in the manufacture of cemented tungsten carbide, the hardest artificial substance in common use. Stellite, a non-ferrous cobalt-chromium tungsten alloy, is very hard and corrosion resistant; it is used for the same purposes as the "high-speed" steels.

Tungsten in rod, wire, or disc form is one of the few metals used commercially in a very pure state. Such industrial tungsten usually has a purity of 99.95 percent, although minute amounts of impurities are added for special applications. Because of its high melting point (3400° C.), low vapor pressure, high tensile strength, and ductility, tungsten is used as filaments for incandescent electric lamps and radio tubes. This uses only small amounts of tungsten, but as yet there is no adequate substitute.

Tungsten compounds are used in dyes and paints, for fluorescent materials in X-ray photography, and as coloring agents in the manufacture of porcelain and stained papers.

The quoted price (October 1949) for domestic scheelite concentrate (60 percent WO_3) is \$28.50 per short ton unit of WO_3, delivered to buyer's plant in carload lots. Actual selling prices are variable, however. Foreign tungsten concentrates are quoted from \$18 to \$19 per unit of WO_3, duty paid, New York.

Ferrotungsten is priced at \$2.25 to \$2.35 per pound of contained tungsten for grades of 75 percent to 80 percent tungsten.

Tungsten powder, 98.8 percent pure, in 1000 pound lots sells for \$2.90 per pound. Tungsten 99.9 plus percent pure, hydrogen reduced, sells for \$4.50 per pound.

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SULFUR

Sulfur is a soft, brittle to imperfectly sectile, non-metallic element. The orthorhombic crystals are commonly acute, pyramidal, or thick tabular. The mineral also occ massive, or as incrustations, Stalactites, stalagmites, or powder. Its fracture is conchoidal to uneven, hardness 1.5 to 2.5, and specific gravity 2.05 to 2.09. Sulfur has a resinous lustre and its characteristically yellow color may be darkened or discolored by impurities. It is a non-conductor of electricity, a poor conductor of heat, and is insoluble in water and in nearly all acids. Sulfur melts at 108° C. and ignites at 270°, burning with a distinctive blue flame yielding sulfur dioxide.

Sulfur occurs not only in its native state but also as the sulphide and sulphate of many metals. These minerals are widely distributed throughout the world, the first two types being the principal sources of commercial sulfur. Considerable amounts are recovered from gases of industrial plants and smelters treating metallic ores.

Deposits of native sulfur are by far the most important. Commercial deposits of this type occur in sedimentary beds with gypsum and limestone associated with hydrocarbons, carbonates, and sulfates. The sulfur formed when the gypsum was reduced by the action of anaerobic bacteria. The deposits of Texas and Louisiana; Sicily; Conil, Spain; Bex, Switzerland; Cracow, Poland; and Eureka Valley, Inyo County, California, all are in this classification, although the last mentioned is believed to be partially due to solfataric action.

Deposits formed near hot springs are superficial and of comparatively small extent although they have been worked at Cody, Wyoming; Cave Creek, Utah; Cuprite, Nevada; and Sulphur Bank, California. In such deposits the sulfur has been formed by the oxidation of hydrogen sulfide. The same action has resulted in the formation of some workable deposits in the craters of volcanoes where the sulfur is deposited in fractures in the surrounding rock. They have been exploited on the island of Kyushu, Japan; Mount Olca and Mount Chupiquina, Chile; and in the vicinity of Lake Rotorua, New Zealand. Sulfur may also be deposited through the alteration of some metallic sulfides, but no commercial deposits of this type are known.

Deposits in Texas and Louisiana supply by far the largest part of the world's need for sulfur today. These deposits occur in an area of some 45,000 square miles, extending from slightly east of the Mississippi River to the vicinity of Corpus Christi, Texas, and inland from the Gulf of Mexico approximately 75 miles. They are known as the salt-dome type of deposit in which the sulfur occurs in stringers and lenses in the lower portion of the limestone cap rock of the domes. In some instances sulfur forms as much as 70 percent of the bulk of the rock. The domes have been formed by the intrusion of the salt into the base of the cap rock, the cap rock being covered by several hundred feet of unconsolidated sands and mud. The force which caused these intrusions to rise from deep-seated salt beds is believed to have been the weight of the sediments. The cap rock also consists in part of gypsum from the alteration of which the sulfur is presumed to have been derived.

The cap rock of the domes varies in thickness from 50 feet to more than 1000 feet. The ore horizons are from 25 feet to 300 feet thick, the average of the commercial deposits being approximately 100 feet. The sulfur content in the various productive domes varies from 20 to 40 percent.

These deposits, discovered in 1868, did not produce until 1902. The production was made feasible by the development of the Frasch process which was first used in that year. Briefly, the Frasch process for mining these deposits may be described as follows. Through pipes in wells drilled from 600 feet to 1100 feet deep, superheated water is introduced into the sulfur beds. The minimum temperature of the water is that of the melting point of sulfur. The molten sulfur is then raised to the surface through another pipe by compressed air and conducted into bins where it solidifies. This process is used throughout the Louisiana-Texas salt-dome fields to produce 90 percent of the sulfur used in the world today.

The sulfur deposits of Sicily, which for many years were the most important producers of this mineral, occur in a cellular limestone interbedded with bituminous shales. These sulfur-bearing limestone strata lie in isolated, basin-like deposits 1 mile to 5 miles long, from 1000 to 3000 feet wide, and having a maximum thickness of 200 feet. The overlying gypsum has greater continuity than the limestone and is covered by formations which include clay, loosely cemented sandstone, argillaceous marls, and limestone interbedded with clay. The sulfur is found disseminated through the limestone, in thin seams parallel to the bedding, or may occur as crystals in the porous phases of the rock. As mined, the grade of the ore averages about 26 percent.

The deposits on the west slope of the Last Chance Range in Inyo County, California, occur along bedding planes and in fractures in steeply dipping limestone beds. Gypsum beds occur with the limestone, and the sulfur is thought to have been largely derived from the reduction of the gypsum initiated by action of carbonic acid.

These deposits were discovered in 1917, since which time several thousand tons of sulfur in the aggregate have been shipped by various operators. These shipments have consisted of both the raw mineral, as mined, and a product refined in retorts at the mines and at Zurich, a station of the Southern Pacific Railroad some 65 miles by road from the deposit.

The most important sulfides from which sulfur is obtained are pyrite (iron sulfide), pyrrhotite (magnetic pyrite), and chalcopyrite (copper pyrite).

Pyrite (FeS_2) when pure contains 53.4 percent sulfur and 46.6 percent iron. It crystallizes in the isometric system, the cube and pyritohedron being the common forms, and has indistinct cleavage, uneven fracture, and brittle tenacity. The mineral has a pale brass-yellow color, metallic luster and greenish-black or brownish-black streak. Its hardness is 6.0 to 6.5 and specific gravity 4.95 to 5.10.

Pyrrhotite, a mineral of variable composition, has a generally accepted formula of $Fe_{11}S_{12}$, which, when pure, contains 38.4 percent sulfur and 61.6 percent iron. The mineral occurs both massive and in tabular or pyramidal crystals of the hexagonal system. Pyrrhotite is bronze in color, has metallic luster and black streak. Its hardness varies from 3.5 to 4.5 and specific gravity from 4.58 to 4.64; it is attracted by a magnet and sometimes possesses polarity.

Chalcopyrite when pure, has the formula $CuFeS_2$, containing 34.5 percent copper, 30.5 percent iron and 35 percent sulfur. Its crystallization is tetragonal-sphenoidal. The luster is metallic, color, brass-yellow, and streak, greenish-black. The hardness varies from 3.5 to 4.0 and specific gravity 4.1 to 4.3.

From these minerals large quantities of sulfur, or sulfurous compounds, have been produced. By far the largest proportion has been in the form of sulfuric acid, although in Spain and Norway, especially, substantial amounts of elemental sulfur have been derived from sulfide sources.

In the United States principal production has come from Ducktown in southeastern Tennessee. Here an ore consisting of pyrrhotite, pyrite, and chalcopyrite is treated for the recovery of sulfuric acid, copper concentrates, and iron sinter.

The largest body of pyrites in the world, reportedly, is that operated by Rio Tinto Company, Ltd., in the Huelva Province of Spain. This deposit is approximately 600 feet wide, 3300 feet long, and 1200 feet deep. By reason of minor amounts of chalcopyrite in the ore, it has for hundreds of years been known as a copper mine. However, the ore is now graded. Material containing 3 percent or more of copper is either smelted for its recovery, with loss of the sulfur, or may be treated with a special charge in blast furnaces, the gases from which operation, in the presence of a catalyst, form sulfur vapor which is condensed to a liquid and allowed to solidify. Ore containing $1\frac{1}{2}$ percent copper but less than 3 percent is leached for recovery of the copper content by intermittently spraying with water huge piles of such material for two or more years. The dissolved copper is precipitated and the residue containing some 49 percent sulfur is treated for its recovery.

Sulfur is also recovered from waste gases from petroleum refineries and casing-head gas. The Hancock Chemical Company of Los Angeles has built a plant near Long Beach which extracts elemental sulfur from the waste gases of the nearby Texas, Richfield Oil, Tide Water Associated, and General Petroleum refineries. The hydrogen sulfide from the refinery gases is absorbed in an 80 percent aqueous solution of diethanol amine and piped to the chemical plant. After a series of heating and stripping processes and partial combustion of the hydrogen sulfide, liquid elemental sulfur is produced in a catalyst-filled converter. Capacity of the plant is now 100 tons of sulfur per day.

The Stanolind Oil and Gas Company started operations at its Elk Basin plant, 18 miles north of Powell, Wyoming, in March, 1949. This plant was designed to extract liquid hydrocarbons and sulfur from the casing-head gas of the Embar-Tensleep reservoir, part of which is in Wyoming and part in Montana. The gas is piped from the various locations to the central plant. A two-stage amine process for the removal of hydrogen sulfide and carbon dioxide is used. A portion of the acid rich gas from the amine plant is burned with controlled amounts of air and again mixed with the unburned portion after which it passes to a reactor containing a bauxite catalyst. Reduction of the sulfur dioxide and oxidation of the hydrogen sulfide takes place over the catalyst, releasing elemental sulfur. This plant produces 74 tons of sulfur per day from 12,000,000 cubic feet of gas.

By far the largest use for sulfur is in the manufacture of sulfuric acid. For this purpose both sulfur and pyrites are used. In the United States large quantities of sulfuric acid are produced as a by-product at copper and zinc smelters. Sulfur is used in the manufacture of numerous products. For the five years prior to 1947 its consumption in the various industries was distributed approximately as follows: chemical, fertilizers and insecticides, 72 percent; pulp, paper, and explosives, 13 percent; dyes, coal tar products, rubber, paint, and varnish,9 percent; miscellaneous, 6 percent.

In 1946 the world production of sulfur amounted to 4,200,000 long tons of which 3,859,642 tons were produced in the United States. Of the domestic production, all but 6,344 tons came from the Louisiana-Texas fields.

The domestic price of sulfur has remained stable for many years at approximately $18, or a little less, per ton. The export price is slightly higher at about $18 to $20 per ton.

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NEW PUBLICATIONS OF THE DIVISION OF MINES

Announcement is made by Olaf P. Jenkins, Chief, Division of Mines, Department of Natural Resources, that the following publications are now ready for distribution: the California Journal of Mines and Geology, Vol. 46, No. 2, April 1950; Bulletin 135 (reprint), Placer Mining for Gold in California, by Charles Volney Averill and others; and Bulletin 147, Geology of the Quien Sabe Quadrangle, California, by Carlton James Leith, including Quicksilver and Antimony Deposits of the Stayton District, California, by Edgar H. Bailey and W. Bradley Myers.

California Journal of Mines and Geology, Vol. 46, No. 2, April 1950

This issue contains Geology and Oil Prospects of Western San Jose Hills, Los Angeles County, California", by Franklin H. Olmsted, which gives the reader an idea of the stratigraphy, structure, and oil prospects of the Miocene and Pliocene sediments which rise above the Quaternary alluvium of the San Gabriel River Valley. Dr. K.O. Emery's paper on "Ironstone Concretions and Beach Ridges of San Diego County, California", is an interesting account of the spherical concretions found on the Linda Vista terrace in San Diego County. A description is given of these concretions, their geological environment and distribution, and their possible economic value.

"Geology of the Red Mountain Magnesite District, Santa Clara and Stanislaus Counties, California", by Alfred J. Bodenlos, is a discussion of the geology and mineral deposits of the Red Mountain area. It includes sections on sedimentary rocks, mineralogy, paragenesis, reserves, and descriptions of several of the mines. The mineral deposits and the methods used to mine them, as well as a description of the topography and geology of Alameda County is described in "Mines and Mineral Resources of Alameda County, California", by Fenelon F. Davis. The paper also includes a tabulated list of the principal mines and mineral deposits.

Also included in this issue of the Journal as a supplement is a reprint of "Manner of Locating and Holding Mineral Claims in California", by A.H. Ricketts, revised by C.A. Logan and Charles V. Averill.

Bulletin 135 (reprint), Placer Mining for Gold in California

This volume is divided into four sections and an appendix and covers the following subjects relating to placer mining for gold in California: Section I, Placer Mining Methods, including small-scale methods, dragline dredging, dry-land dredges, bucket-line dredging, Becker-Hopkins single-bucket dredge, jigging, notes on jigs for gold dredges, treatment of black sand, drift mining, hydraulic mining, and debris dams. Section II, Geology of Placer Deposits, includes an article on a new technique applicable to the study of placers. Section III, Prospecting and Sampling Placer Deposits, includes articles on sampling and geophysical prospecting. Section IV, is a section on Placer Mines by Counties. Section V, contains the Laws Affecting Placer Mining in California, including the Caminetti Act and its amendments, definitions of hydraulic mining, restrictions imposed by Fish and Game Code for the Trinity and Klamath River Fish and Game District and for the protection of domestic water supplies.

Authors who have contributed to the bulletin include F.W. Collins, L.L. Huelsdonk, Olaf P. Jenkins, P. Malozemoff, C.M. Romanowitz, H.A. Sawin, and H.H. Symons.

Three maps are included in a pocket on the back cover of the bulletin. These are: (1) Map showing Tertiary gravel channels, Nevada County, scale 2"= 3 mi.; (2) Geologic map of northern Sierra Nevada showing Tertiary river channels and Mother Lode gold belt, scale 1"= 8 mi. (reprint); (3) Map of northern California showing placer mining areas (principal rivers and creeks from which gold was produced in 1932 by individual small-scale hand placer operators) scale ½"= 10 mi., approx. (reprint).

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Bulletin 147, Geology of the Quien Sabe Quadrangle, California, and Quicksilver and Antimony Deposits of the Stayton District, California

The Quien Sabe quadrangle, located 90 miles southeast of San Francisco and 13 miles east of Hollister, covers portions of the counties of San Benito, Merced, and Santa Clara. It includes a portion of the crest of the Diablo Range of the central Coast Ranges of California, and lower rolling country toward the San Joaquin Valley to the east. It is one of a series of such bulletins on specific areas in California which the Division of Mines is engaged in publishing.

This bulletin has sections on geomorphology, stratigraphy, structure, geologic history, and economic geology (including discussions on the manganese, antimony, and quicksilver prospects located in the area). It contains 2 figures and 7 plates, including colored geologic and economic mineral maps, scale 1:62,500, an index map, stratigraphic column, and a structure section. The book also contains 4 pages of pictures.

Included in this same bulletin is a detailed economic report prepared by the Geological Survey, Department of the Interior, Quicksilver and Antimony Deposits of the Stayton District, California, by Edgar H. Bailey and W. Bradley Myers. The Stayton district is located within the Quien Sabe quadrangle and is the principal commercial mineral-bearing area in it. It contains 4 plates and 4 figures, including economic maps and sections, an index map, and three geologic maps. It includes a description of the history and production, geology, ore deposits, reserves, suggestions for prospecting, and a description of the mines.

Olaf P. Jenkins, Chief
State Division of Mines
Ferry Building
San Francisco 11, California

Date ____________________

Please send me:

- _____ copies of Bulletin 135, Placer Mining for Gold in California, @ $2.50 each.
- _____ copies of Bulletin 147, Geology of the Quien Sabe Quadrangle, California, and Quicksilver and Antimony Deposits of the Stayton District, California, @ $1.75 each.
- _____ copies of the California Journal of Mines and Geology, Vol. 46, No. 2, April 1950, @ $1.00 each.

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DIVISION OF MINES
Ferry Building, San Francisco 11
OLAF P. JENKINS, Chief

MINERAL INFORMATION SERVICE

VOL. 3 July 1, 1950 No. 7

ASSESSMENT WORK

The following bill has been signed by the President as we go to press on June 15:

"81st Congress, 1st Session, H.R. 6406.

"A Bill

Providing procedure for claimants of mining claims in the United States obtaining credit for assessment work performed during the year ending July 1, 1949, under the provisions of Public Law 107, Eighty-first Congress.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That every claimant of a mining claim in the United States who wishes to obtain the benefits conferred by the second proviso to the first section of the Act of June 17, 1949 (Public Law 107, Eighty-first Congress), may file, or cause to be filed, in the office where the location notice or certificate is recorded, on or before 12 o'clock meridian on the 1st day of July 1950, a statement of the labor performed or improvements made on any such mining claim during the year ending July 1, 1949, or such statement may be included as part of the annual notice of the performance of assessment work for the year ending at 12 o'clock meridian on the 1st day of July 1950."

The following appeared in the Bulletin of the American Mining Congress, dated June 5, 1950:

"The Senate Committee on Interior and Insular Affairs today ordered reported S. 3639 by Senator Cordon (Rep., Ore.), which would extend until October 1, 1950 the time in which mining claim-holders may perform assessment work for the current year. In order to take advantage of this extension the claimant must file, in the office wherein the location notice or certificate is recorded, on or before 12 o'clock Meridian, July 1, 1950, a notice of his desire to hold such mining claim".

S. 3639 had not yet become law on June 14, as evidenced by the following telegram from Congressman Clair Engle, dated June 14:

"S 3639 reported favorably by House Public Lands Committee."

Anybody in doubt about the status of his assessment work after noon of July 1, 1950 should start his assessment work for the year 1950-1951, and work continuously on it until it is completed. The requirement is one-hundred-dollars in labor or improvements on each claim each year. Such work will revive the claimant's title to his claim in the absence of any adverse intervening location.

MINING AND INDUSTRIAL NEWS NOTES

Calaveras County Lode Operation

Some high-grade gold ore has been developed on the 200-foot level of the Skyrocket mine at Hodson (near Copperopolis), Calaveras County. The ore body, which extends along the vein for 90 feet, was discovered by crosscutting from the 205-foot inclined shaft. The mine is being worked by the Mount Diablo Exploration Company with offices at 1515 W. Jefferson Blvd., Los Angeles. C. B. Wood of Copperopolis is mine superintendent and 10 men are employed.

Fresno County Gold Dredge

An 8-inch suction dredge began operating on the Fresno side of the San Joaquin River $2\frac{1}{2}$ miles above Lane's Bridge about the first of June. A digging bit connected with the suction dredge oscillates through an arc of 90 degrees. Holes in the bit exclude all rock larger than 3 inches. Gold is recovered by amalgamation in riffles and screen covered sluice boxes. After the current testing period is over the dredge will operate three shifts per day, pumping 70-80 cu. yds. per hour. Construction and operation of the dredge have been conducted by Fred Santoni of Fresno.

Iron Exploration in Shasta County

Two deep diamond drill-holes will be sunk at Iron Mountain near Redding under direction of the U. S. Geological Survey. The holes will be drilled to obtain geological information on the mineralization at Iron Mountain and to prospect a structure that on the basis of surface geologic mapping is believed to have been favorable for ore deposition. The drilling contract has been awarded to R. C. McClintock of Spokane, Washington by the U. S. Geological Survey. The current Shasta County iron investigations are part of a cooperative program of the State Division of Mines and the U. S. Geological Survey.

RECENT GIFTS TO THE DIVISION OF MINES LIBRARY

The Division of Mines is happy to add to its collection of films "The Story of the Cup", a pictorial account of the production of Franciscan ware in the plants of Gladding, McBean & Co. This is a 16mm. film tracing the manufacture of china utensils from raw products to finished items. Films in the Division library may be obtained on loan for group showings. Reservations for films should be placed well in advance of the desired date.

A large collection of technical publications for the San Francisco Division of Mines library has been received from the library of Mr. W. S. T. Smith including many scarce U. S. G. S. folios. The collection includes 23 volumes of U. S. Geological Survey *Mineral Resources of the United States*; vols. 1-19 of *Journal of Geology*; 43 assorted U. S. G. S. bulletins; 21 U. S. G. S. folios including Smartsville and San Luis in California; and 16 miscellaneous volumes on geology, mineralogy and mining.

The library of the Los Angeles office of the Division has received from Mrs. Maude Thorndyke of Inglewood sixteen books and miscellaneous publications on mining, geology and mineralogy. The collection includes several textbooks and reference source books, together with several interesting publications on Arizona geology and mineral deposits.

The Division of Mines is very grateful to Gladding, McBean & Co., Mr. W. S. T. Smith, and Mrs. Maude Thorndyke for the foregoing additions to its technical library.

NEW PUBLICATIONS OF THE DIVISION OF MINES

Bulletin 151, concerning the geology and mineral deposits of north central California adjacent to the Oregon border, is now being distributed. It contains the "Geology of the Macdoel Quadrangle, California" by Howel Williams, Professor of Geology at the University of California, and "Circular Soil Structures in Northeastern California" by Peter K. Masson, geologist, Humble Oil Company.

The area covered in Dr. Williams' report includes parts of Shasta and Butte Valleys and the Cascade Range as well as a portion of the Klamath River Valley. The text covers both the areal and structural geology as well as the mineral deposits; the maps consist of colored geologic and economic mineral maps and an index map. Microdrawings illustrate the volcanic rocks of the region.

Mr. Masson's article concerns the origin of a number of interesting circular rock and soil structures about which frequent inquiries have been received by the Division of Mines.

Bulletin 151 sells for $1.75, cloth bound; California residents please add 3% sales tax.

Bulletin 152, Manganese in California, by Parker D. Trask and others, is ready for circulation. In this book are detailed descriptions of the many manganese deposits of the state which were omitted from the summary of manganese deposits which appears in the third chapter of Bulletin 125, published by the Division of Mines in 1943. Bulletin 152 is, therefore, a supplement to Bulletin 125, and the method used in numbering and describing the properties is the same as that employed on Economic Mineral Map of California, No. 5, which accompanied Bulletin 125.

Two world wars have been served by the many manganese deposits of California, although in times of peace they have produced little. During World War II, the state was second only to Montana in domestic manganese production. At least 800 deposits from 675 localities in 44 counties are known. Production to the end of 1946 has been 168,000 tons valued at more than $5,000,000.

The text of both Bulletin 125 and 152 should serve as a guide and stimulus for further manganese research. As a detailed record of all the state's known resources of manganese, "Manganese in California" should be of inestimable value should the nation again become involved in a war where foreign sources are curtailed.

Bulletin 152 represents the results of a cooperative undertaking between the U. S. Geological Survey and the California State Division of Mines. The deposits are arranged alphabetically by county and there are numerous geologic maps, mine maps, and drawings of mine workings.

The bulletin cloth bound sells for $2.75; California residents please add 3% sales tax.

MINE PRODUCTION BY COUNTIES (CONT'D.)

County	Copper		Lead		Zinc		Total Value
	Pounds	Value	Pounds	Value	Pounds	Value	
Amador	300	$ 59	100	$ 16	--	$ --	$ 676,657
Butte	--	--	--	--	--	--	822,315
Calaveras	76,500	15,070	33,300	5,261	726,700	90,111	224,423
El Dorado	--	--	--	--	--	--	109,702
Fresno and Humboldt (2)	--	--	--	--	--	--	7,799
Imperial	--	--	--	--	--	--	1,128
Inyo	421,300	82,996	19,659,100	3,106,138	8,952,200	1,110,073	4,974,866
Kern	--	--	--	--	--	--	215,878
Los Angeles	--	--	--	--	--	--	8,826
Madera	--	--	--	--	--	--	43,464
Mariposa	200	39	--	--	--	--	235,432
Merced	--	--	--	--	--	--	433,526
Modoc	--	--	--	--	--	--	318
Mono and Monterey (2)	100	20	300	47	--	--	2,697
Nevada	--	--	900	142	--	--	(3)4,108,689
Placer	--	--	--	--	--	--	51,760
Plumas	3,500	690	--	--	--	--	24,562
Riverside	5,100	1,005	31,500	4,977	--	--	8,488
Sacramento	--	--	--	--	--	--	3,706,626
San Bernardino	135,500	26,694	320,700	50,671	618,300	76,669	267,030
San Diego	--	--	--	--	--	--	107
San Francisco	--	--	--	--	--	--	106
San Joaquin and Stanislaus (2)..	--	--	--	--	--	--	537,760
Shasta	653,900	128,818	589,900	93,204	4,120,800	510,979	1,082,466
Sierra	--	--	--	--	--	--	474,859
Siskiyou	1,600	315	--	--	--	--	534,743
Trinity	--	--	--	--	--	--	113,713
Tulare	--	--	--	--	--	--	914
Tuolumne	--	--	200	32	--	--	13,123
Yuba	--	--	--	--	--	--	(3)1,934,585
Total: 1949	1,298,000	255,706	20,636,000	3,260,488	14,418,000	1,787,832	20,616,562
1948	962,000	208,754	18,220,000	3,261,380	10,650,000	1,416,450	20,294,093

(1) Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
(2) Combined to avoid disclosure of individual output.
(3) Yuba County lode gold and lode silver included with Nevada County.

Prepared by R. B. Maurer, San Francisco Office, United States Bureau of Mines, in cooperation with the State of California, Department of Natural Resources, Division of Mines.

MINE PRODUCTION BY COUNTIES (CONT'D.)

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Amador	4,120	$ 3,729	92	$ 83	4,212	$ 3,812
Butte	3	3	1,571	1,422	1,574	1,425
Calaveras	9,012	8,156	22	20	9,034	8,176
El Dorado	482	436	305	276	787	712
Fresno and Humboldt (2)	--	--	32	29	32	29
Imperial	9	8	--	--	9	8
Inyo	591,391	535,239	--	--	591,391	535,239
Kern	17,490	15,829	65	59	17,555	15,888
Los Angeles	99	90	24	21	123	111
Madera	8	7	334	302	342	309
Mariposa	853	772	869	786	1,722	1,558
Merced	--	--	1,139	1,031	1,139	1,031
Modoc	3	3	--	--	3	3
Mono and Monterey (2)	1,166	1,055	--	--	1,166	1,055
Nevada	(3) 34,686	(3) 31,392	276	250	(3) 34,962	(3) 31,642
Placer	1,292	1,169	56	51	1,348	1,220
Plumas	18	16	62	56	80	72
Riverside	951	861	--	--	951	861
Sacramento	5	5	4,929	4,461	4,934	4,466
San Bernardino	26,148	23,665	89	81	26,237	23,746
San Diego	2	2	--	--	2	2
San Francisco	--	--	1	1	1	1
San Joaquin and Stanislaus (2)	--	--	1,414	1,280	1,414	1,280
Shasta	75,637	68,455	807	730	76,444	69,185
Sierra	2,573	2,329	33	30	2,606	2,359
Siskiyou	35	32	1,952	1,766	1,987	1,798
Trinity	24	22	399	361	423	383
Tulare	--	--	4	4	4	4
Tuolumne	76	69	2	2	78	71
Yuba	(3)	(3)	3,320	3,005	(3) 3,320	(3) 3,005
Total: 1949	766,083	693,344	17,797	16,107	783,880	709,451
1948	703,289	636,512	21,482	19,442	724,771	655,954

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1949, by counties, in terms of recovered metals. The values were calculated at the following prices: gold, $35 a fine ounce; silver, $0.9050505 a fine ounce; copper, $0.197 per pound; lead, $0.158 per pound; and zinc, $0.124 per pound.

County	Mines producing (1)		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Amador	10	11	18,551	$ 649,285	671	$ 23,485	19,222	$ 672,770
Butte	2	10	19	665	23,435	820,225	23,454	820,890
Calaveras	11	4	2,839	99,365	184	6,440	3,023	105,805
El Dorado	8	12	1,071	37,485	2,043	71,505	3,114	108,990
Fresno and Humboldt (2)	--	4	--	--	222	7,770	222	7,770
Imperial	1	--	32	1,120	--	--	32	1,120
Inyo	44	1	4,003	140,105	9	315	4,012	140,420
Kern	25	3	5,447	190,645	267	9,345	5,714	199,990
Los Angeles	3	2	92	3,220	157	5,495	249	8,715
Madera	2	8	29	1,015	1,204	42,140	1,233	43,155
Mariposa	21	7	2,777	97,195	3,904	136,640	6,681	233,835
Merced	--	3	--	--	12,357	432,495	12,357	432,495
Modoc	1	--	9	315	--	--	9	315
Mono and Monterey (2)	3	--	45	1,575	--	--	45	1,575
Nevada	12	12	(3) 114,110	(3)3,993,850	2,373	83,055	(3) 116,483	(3)4,076,905
Placer	3	15	946	33,110	498	17,430	1,444	50,540
Plumas	7	5	33	1,155	647	22,645	680	23,800
Riverside	6	--	47	1,645	--	--	47	1,645
Sacramento	1	12	30	1,050	105,746	3,701,110	105,776	3,702,160
San Bernardino	32	3	2,054	71,890	496	17,360	2,550	89,250
San Diego	1	--	3	105	--	--	3	105
San Francisco	--	1	--	--	3	105	3	105
San Joaquin and Stanislaus (2)	--	6	--	--	15,328	536,480	15,328	536,480
Shasta	13	4	663	23,205	7,345	257,075	8,008	280,280
Sierra	5	15	13,242	463,470	258	9,030	13,500	472,500
Siskiyou	12	22	204	7,140	15,014	525,490	15,218	532,630
Trinity	6	20	82	2,870	3,156	110,460	3,238	113,330
Tulare	--	1	--	--	26	910	26	910
Tuolumne	12	1	355	12,425	17	595	372	13,020
Yuba	1	8	(3)	(3)	55,188	1,931,580	(3) 55,188	(3)1,931,580
Total: 1949	242	190	166,683	5,833,905	250,548	8,769,180	417,231	14,603,085
1948	241	195	135,917	4,757,095	285,556	9,994,460	421,473	14,751,555

ABRASIVES

During the past few decades the industrial use of abrasives has greatly increased. Most major industries use one or more types of abrasive material, and abrasive production closely parallels industrial activity. At present, sand, pumice, and volcanic ash are the only abrasives produced in quantity in California, although others are available. The following table lists and classifies the principal abrasives in use today:

- I Natural Abrasives
  - (1) High grade natural abrasives
    - (a) Diamond
    - (b) Corundum
    - (c) Garnet
  - (2) Siliceous natural abrasives
    - (a) Sandstone and sand
    - (b) Quartz and quartzite
    - (c) Grinding pebbles
    - (d) Diatomite
    - (e) Tripoli
    - (f) Feldspar
    - (g) Kaolin
    - (h) Talc
    - (i) Pumice and pumicite
- II Artificial Abrasives
  - (1) Silicon carbide
  - (2) Crystalline oxide of aluminum
  - (3) Boron carbide

I Natural Abrasives

Diamond

Since the early days of the gold industry in California, diamonds have occasionally been found in gold placers. More than 300 good quality diamonds have been taken from the Cherokee district placers in Butte County. Exploration for the source rocks has to date been unsuccessful and none of the placer deposits can be considered a potentially commercial source of abrasive diamonds. All of the world's known primary occurrences of diamonds are in pipes of serpentinized ultra-basic rocks. Such rocks were undoubtedly the source of California's placer diamonds.

Corundum

Occurrences of corundum (Al_2O_3) are uncommon in California and those that are known have not been considered commercially exploitable. Though corundum deposits in the Appalachian belt of the eastern United States have been operated in the past, all corundum for domestic consumption is now imported, principally from the Union of South Africa. Most commercial deposits of corundum are in bodies of silica-poor igneous rocks, but the California occurrences are mostly in metamorphic rocks.

Garnet

Garnet, an important natural abrasive, occurs at many localities throughout California, but has not been mined in quantity. Garnet is a constituent of many metamorphic rocks, and some igneous rocks, but sources of abrasive garnet are invariably of metamorphic origin. To be of commercial interest such deposits must contain relatively large tonnages of rock composed of more than 10 percent of recoverable garnet. The recoverable garnet should be in grains 3/16 of an inch in diameter or larger.

The six main subspecies of garnet are composed of different combinations of the silicates of magnesium, aluminum, iron, calcium, manganese, and chromium. The three most common types are grossularite ($Ca_3Al_2(SiO_4)_3$), which occurs chiefly in crystalline limestone as the product of contact metamorphism; and andradite ($Ca_3Fe_2(SiO_4)_3$) and almandite ($Fe_3Al_2(SiO_4)_3$), both of which occur in schists and gneisses as a common product of regional metamorphism.

The production of garnet in California is currently confined to a single source. Since 1938, Huntley Industrial Minerals, Inc. annually has produced small amounts of abrasive garnet from tungsten-ore mill-tailing obtained from deposits in the Pine Creek district, Inyo County. In these deposits the tungsten-bearing rock is a medium-to-fine-grained garnet-diopside rock. The garnet, after separation from the tailings, is marketed as a blast sand, and has been used principally by the aircraft industry.

An andradite garnet deposit northwest of Cadiz Station, San Bernardino County, was prospected in 1931-1932 by Pacific Coast Garnet Company, but the property has not yet been developed. A few tons of garnet rock were mined at the Sunny Day mine near Indio, Riverside County in 1936-1937, but were not shipped.

Virtually the entire world's production of abrasive garnet comes from two localities in New York State, and one in New Hampshire. At each of these almandite garnet is produced from schists and gneisses. The average ore contains from 10 to 15 percent garnet, and some as much as 60 percent.

About nine-tenths of the abrasive garnet produced in the United States is used in the manufacture of abrasive papers and cloths. The remaining tenth is used principally as loose grains for polishing and blasting. Garnet abrasive-paper and cloth is consumed largely by the manufacturing industries in the finishing of wood, leather, hard rubber, celluloid, felt and silk hats, painted and varnished surfaces, and for other miscellaneous uses. Garnet abrasives play an important part in the fabricating industries, but the demand for garnet has declined steadily since 1923, owing to the competition from manufactured abrasives.

In April 1950 the New York price for Adirondack garnet-grain concentrates was $85.00 a ton, but the by-product garnet from the California tungsten tailings has been valued between $16 and $18 per ton.

Sand, Sandstone and Crushed Rock

In 1948 approximately 100,000 tons of sand, sandstone, and crushed rock were marketed in California for abrasive purposes. This was consumed mostly as sand-blasting material. The bulk of this material in California is obtained from the natural sands bordering Monterey Bay. Here, by means of draglines, dune and beach sands are mined. The beach sand is re-supplied by wave action almost as fast as it is removed, and draglines have been operating at the same locations for several years. Some of this sand is marketed as it is taken from the beach, and some is dried, screened, and remixed to the buyer's specifications. The beaches of southern California, notably the El Segundo area, yield a small amount of blasting sand for local consumption.

Small amounts of crushed rock, chiefly dacite porphyry, are also produced in California as sand-blasting material. Such materials are quarried a few miles south of Corona, Riverside County. Being tough and angular, this crushed rock is an excellent blasting material; but its high cost restricts it to specialized uses.

The principal consumers of sand-blasting materials are shipyards, railroads, aircraft factories, and other metal-working industries. The increased industrial activity in California, particularly in the war-expanded shipyards and aircraft plants, has led to a marked rise in blasting sand output. Blasting material of the beach-sand type is being marketed in the $5.00 to $10.00 per ton price range; crushed rock blasting material is sold for approximately twice as much. A small demand still exists for fabricated natural sandstone abrasives such as grindstones, pulpstones, and millstones. There are no plants in California producing such articles, however, and the demand for them is decreasing. These stones are obtained from massively-bedded deposits, free from closely-spaced joints, and containing sharp, well sorted, and evenly-cemented quartz grains.

Quartz and Quartzite

Quartz and quartzite are often ground, and graded to produce a silica abrasive. Such material can be used for many of the abrasive purposes for which natural silica sand is used, and it is generally sharper than the natural product. Quartz and quartzite are abundant in California, but have not been mined as abrasive materials in appreciable quantities.

Grinding Pebbles

For over 30 years a small annual production of grinding-mill pebbles has been obtained from deposits in California. Most of this production has come from San Diego County, where the pebbles are found along the ocean beach. The pebbles are of several rock types, and those of sufficient hardness and toughness for mill grinding must be selected by hand.

Diatomite

California, the largest producer of diatomite in the world, accounts for about 98 percent of the United States' production; but of this amount only an insignificant percentage is used as an abrasive. The abrasive uses of diatomite are mainly confined to metal polishes and dental powders.

Tripoli

Tripoli is a porous, earthy substance, composed almost entirely of silica. The name is loosely applied to many siliceous substances used for abrasives, but in a restricted sense, it applies to certain fine-grained rocks found in the Missouri-Oklahoma area. Tripoli from this area is an even-textured rock, the grains of which are mostly less than .01 mm in diameter. Tripoli is shaped into blocks for many abrasive and filtering purposes, and is also ground into a powder for cleansing and polishing. The origin of tripoli is uncertain, but it is thought to be a residual product of the weathering of siliceous limestones. No occurrences of tripoli have yet been noted in California.

Feldspar and Kaolin

Although the main consumption of feldspar and kaolin is for non-abrasive purposes, these minerals are important soft abrasives. Ground feldspar is the main ingredient of many household scouring powders, and kaolin has been used for polishing silverware. Feldspar and kaolin from California sources generally have not been marketed as abrasives, though a suitable supply is available.

Talc

A very small part of California's yearly talc production is used as an abrasive for polishing soft metals, leather, and rice grains.

Pumice and Pumicite

Between five and ten thousand tons of the pumice and pumicite mined in California during 1948 was marketed as abrasive material. This was less than five percent of the state's total pumice and pumicite output for the year, most of which was used as light-weight aggregate.

Pumice and pumicite are volcanic rocks which differ only in particle size and degree of fragmentation. Pumice is a natural frothy glass resulting from the gaseous expansion of siliceous lava. It contains abundant air cells and commonly will float on water. Pumicite, also known as volcanic ash, is an aggregate of small glass shards, and is a product of the volcanic fragmentation of pumice. At seven localities in the state, pumice and pumicite have been mined in relatively large quantities as abrasive materials, and in 1948, six of these were active. The volcanic rocks of these deposits range from late Tertiary to Recent in age and all have apparently originated from volcanism in the eastern portion of the state.

A deposit of pumicite near Shoshone, Inyo County, has been worked intermittently and marketed as an abrasive for over 20 years. The pumicite is a layer in nearly horizontal Pleistocene lake beds. It averages 12 feet in thickness, and is extensively exposed. It is uniformly fine-grained and very friable, and is shipped to the Los Angeles area where it is sold as a cleanser agent.

Pumice and pumicite produced from the Last Chance Canyon area of the El Paso Mountains, Kern County, have been used as abrasive substances. In this area a series of volcanic rocks containing pumiceous layers is overlain by pumicite-bearing lake beds. Both the volcanic rocks and lake beds are Pliocene (?) in age and are moderately deformed.

For a period of about 25 years previous to 1947 a pumicite layer in the Last Chance Canyon beds was worked by the Cudahy Company which used the product as an abrasive ingredient in Old Dutch Cleanser. The layer averages eight to nine feet in thickness, and it is interbedded with silicified lake sediments. Its exposures have been traced along strike for a distance of about 2½ miles.

Pumice from the Last Chance Canyon volcanic rocks is being mined by the Calsilco Corporation and is sold in part as an abrasive material. It is obtained from a layer eight to twenty feet thick interbedded with basalt flows. The product is ground to different sizes. It is used in scouring powder and tooth powder and in such non-abrasive applications as ceiling insulation, accoustical plaster, wood filler, and metallic paints.

Pumice for use as an abrasive is also obtained from a deposit on the western slope of the White Mountains northeast of Laws, Mono County. The pumice deposit is a bed in a fanglomerate. It is approximately 20 feet thick and has been uncovered over an area approximately 600 feet long. The product is ground and used as a scouring powder and in other polishing and grinding compounds.

A pumice bed, 20 to 25 feet thick, is exposed in Madera and Fresno Counties on both sides of the San Joaquin River near Friant. This bed is quite extensive and is being worked for abrasive material.

Blocky pumice is being mined from a pumice dome near the north end of Mono Craters in Mono County. This material is relatively strong and compact. It is sawed to specified sizes at Leevining and marketed as scouring blocks.

Scouring blocks are also being cut from pumice obtained at a deposit at Glass Mountain in the Medicine Lake Highland, Siskiyou County. Here pumiceous and scoriaceous material has formed as a surface phase of Recent obsidian flows.

Nearly all of the pumice and pumicite produced as abrasive material in California has been obtained from open cuts. Some of the development at the Cudahy property, however, employed underground methods.

II Artificial Abrasives

At the present time, none of the three principal artificial abrasives are manufactured in California. However, natural materials which are available for the production of two of them, silicon carbide and boron carbide, may well form the basis of a future artificial abrasive industry within the state.

Silicon Carbide

Silicon carbide, known by the trade name "Carborundum", is the most widely used artificial abrasive. It has a hardness on the moh scale of between 9.5 and 9.75, and is the lightest of the high grade abrasives. The method used for preparing silicon carbide today is virtually the same as that used by its discoverer, Dr. E. G. Acheson, in 1891. It is a batch process in which iron free, pure quartz sand, (ground quartz could be used) and petroleum coke are placed in an electric furnace and fired for 36 hours. Silicon carbide forms in the center of the furnace as needle-like, highly irridescent crystals. These crystals are then crushed, ground, and graded for use in grinding wheels, on abrasive papers, and in other abrasives products. All necessary materials for the manufacture of silicon carbide are obtainable in California.

Fused Alumina

The present process of manufacturing fused alumina, or artificial corundum, requires bauxite as a raw material. As commercial deposits of bauxite have not been developed in California, there has so far been no production of fused alumina.

Boron Carbide

Boron carbide, the hardest known manufactured substance, was first placed on the market in 1934, under the trade name Norbide. It is chemically inert and almost as hard as diamond; however, its low tensile strength prevents its use as grit in grinding wheels. Boron carbide is used extensively as a substitute for diamond dust in cutting and polishing, and when heated to 2450°C it can be molded into such useful items as sandblasting nozzles and gauge tips.

Boron carbide, like silicon carbide, is produced in an electric furnace. Water is evaporated from chemically-pure boric acid crystals to form a glass-like anhydrous oxide. This oxide is mixed with high-grade petroleum coke, and placed in an electri furnace. The charge is fired, and at approximately 5000°F boron carbide crystal (B_4C or B_6C) are formed. As California produces practically the entire world' supply of borates, all the raw materials necessary for the manufacture of bo bide are available in the state.

Artificial abrasive industries have been developed principally in areas where an abundant and economical source of electric power is available. At present there is no electric power surplus in California, although future hydro-electric development may remedy this situation.

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DEPARTMENT OF NATURAL RESOURCES
WARREN T. HANNUM, Director

DIVISION OF MINES
Ferry Building, San Francisco 11
OLAF P. JENKINS, Chief

MINERAL INFORMATION SERVICE

VOL. 3 August 1, 1950 No. 8

1950

ASSESSMENT WORK

The President on June 29 signed into law S. 3639 which extends from July 1, 1950 to October 1, 1950 the time in which claimholders may perform their assessment work for the current year. The provision that an intention to hold should be filed before 12 o'clock meridian on the first day of July, 1950 was removed from the bill before it became a law.

Following is a verbatim copy of the bill signed by the President:

"An Act providing for an extension of the time during which annual assessment work on mining claims held by location in the United States, including Alaska, may be made, and for other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the time during which labor may be performed or improvements made, under the provisions of section 2324 of the Revised Statutes of the United States, on any unpatented mining claim in the United States, including Alaska, for the period commencing July 1, 1949, is hereby extended until the hour of 12 o'clock meridian on the 1st day of October, 1950: Provided, that assessment work or improvements required for the year ending at 12 o'clock meridian July 1, 1951, may be commenced immediately following 12 o'clock meridian July 1, 1950."

Mr. Aspinall, from the Committee on Public Lands, submitted the following:

Explanation of the Bill (H. R. Report No. 2248)

S. 3639, as amended, extends for 3 months the time allowed for the performance of annual assessment work on mining claims in the United States, including Alaska, for the period commencing July 1, 1949.

This proposed legislation involves section 2324 of the Revised Statutes (30 U.S.C., sec. 28), which requires an expenditure of at least $100 in labor or improvements of a mining nature to be made during each year on all mining claims located in the United States, including Alaska.

The Congress has suspended assessment-work requirements since 1941. In the past few years legislation for the purpose was not enacted until near the end of each assessment year, which ends July 1. As a result, many claimants of mining claims, finding that relatively few gold, silver, and other domestic mineral deposits are susceptible to economic exploitation under today's conditions, have been reluctant to perform annual assessment work and have deferred the performance of such work in the hope or expectation that the Congress would again provide for the suspension of assessment-work requirements before July 1. In addition, it is reported that many in the northwest who normally perform their assessment work during May and June find their mining claims to be inaccessible as the result of heavy snows and unseasonable weather in the mountain areas. The 3-month extension of time provided by the present bill would grant such claimants the additional time they now require for the performance of their assessment work. Mining claims on which annual assessment work is not performed are subject to relocation by others.

The 3-month overlap of two assessment years between July 1 and October 1, 1950, will permit those who have not performed their assessment work for the period commencing July 1, 1949, to perform labor or make improvements valued at $200 or more on each claim and thereby also complete their assessment work for the period commencing July 1, 1950.

Although the Committee on Public Lands is agreeable to the enactment of this bill, the committee is of the opinion that the outright suspension of the annual assessment-work requirement on mining claims held by location is no longer necessary or desirable. The committee strongly recommends that no further legislation be enacted for the outright suspension of annual assessment-work requirements either for the current period or for future years, periods of national emergency excepted.

The committee is also of the opinion that further extensions of time for the performance of such annual assessment work should not be granted unless there is a showing of most unusual circumstances or the existence of a national emergency.

MINING AND INDUSTRIAL NEWS NOTES

Barite in Plumas County

The Savercool barite mine in the Almanor district of Plumas County has been reopened by Barium Products, Limited. The barite is mined from stopes on a vein developed by an adit and raises. Shipments are made by rail from a siding at Canyon Dam to their processing plant at Modesto. The property has been idle since December, 1948.

Shasta County Copper-Zinc

The improved market for copper and zinc has induced the Coronado Copper and Zinc Company to reopen their Afterthought mine at Ingot, Shasta County, July 1. The property has a 75 ton selective flotation plant and produces concentrates of copper, zinc, and lead sulphides. The concentrates, which contain silver and gold, are shipped to Tacoma, Washington, and Great Falls, Montana, for smelting. The mine has been idle since July, 1949.

Mountain Pass Bastnasite

Late in 1949 a discovery of bastnasite, the fluocarbonate of cerium and lanthanum, was made near Mountain Pass, San Bernardino County, California. This discovery reveals the only known primary bastnasite mineralization in the world which has possibilities of becoming a commercial deposit under present conditions.

Shortly after the discovery, two geologists of the U. S. Geological Survey were assigned to map in detail a small area in the immediate vicinity of the original claims. According to their findings, the bastnasite occurs in distinct carbonate veins associated with barite, fluorite, limonite, hematite, siderite, quartz, and a small amount of galena. Also present are small amounts of uranium and thorium, probably not in sufficient quantity to be of interest to the Atomic Energy Commission. The country rock enclosing the veins has been classified as shonkinite (an unusual type of plutonic rock consisting predominantly of augite, and potash and soda feldspars without quartz). The shonkinite is a localized mass which is intrusive into Archean schists and gneisses. This intrusive mass is cut by numerous basic dikes, with which the mineralization may be associated. The age of the mineralization is not known but could be as late as Tertiary.

The bastnasite veins were originally discovered with the aid of a Geiger counter and since then numerous prospectors using similar equipment have located additional veins and have extended the limits of the mineralization considerably. As it is now known, the mineralized area extends from the original location (about 1 mile north of Mountain Pass) southeasterly for about 4 miles, nearly paralleling the Clark Mountain normal fault. The geology outside of the area mapped by the Geological Survey is not well known, but the bastnasite veins appear to occur in the Archean rocks and the shonkinite intrusive body apparently is absent.

Early in 1950, the Molybdenum Corporation of America purchased the original 16 claims and has since started development work on them. At present they are engaged in sinking a 2-compartment shaft to the 100-foot level, from which point they plan to drive cross-cuts to the two largest veins. Soft ground which slacks on exposure to air necessitates timbering of the entire shaft. Activity at other claims in the area has been confined largely to discovery work. However, some operators are doing a small amount of development work.

View looking east-northeast at Molybdenum Corporation of America's bastnasite operation at Mountain Pass, California. The Clark Mountains lie several miles to the left of the area shown in the photo.

led

$3H_2O$)

Spectrographic analyses of Molybdenum Corporation's ore have been made in the Division of Mines laboratory. They reveal the presence of the following elements in the ore: Si, Mn, Mg, Ho, Fe, Ba, Al, Cu, Zn, Pb, Ti, Ca, F, O, C, Ce, Th, Cs, La, In, Ga, and Rb.

The true economic significance of the Mountain Pass bastnasite mineralization will not be determined until Molybdenum Corporation has had adequate time to test their property with underground workings. Providing the deposits prove out well, the area should be able to produce sufficient amounts of bastnasite to meet the United States' needs for cerium and lanthanum and should eventually make this country independent of foreign sources.

ACKNOWLEDGEMENT

The Division of Mines gratefully acknowledges the gift of the following volumes to its technical library:

From the San Diego Natural History Museum Library:

American Geophysical Union, Transactions, 1940, pt. I, III, 1941, pt. I.
Clarke, John M., The higher Devonian faunas of Ontario County, New York: U. S. Geol. Survey, Bull. 16, 1885.
Geological Magazine, vol. 180, no. 1, 1943, vol.181, no. 1, 1944.
Hague, Arnold, and Iddings, Joseph P., On the development of crystallization in the igneous rocks of Washoe, Nevada, with notes on the geology of the district: U. S. Geol. Survey Bull. 17, 1885.
Hannibal, Harold, A synopsis of the Recent and Tertiary freshwater mollusca of the California province based upon an ontogenetic classification: excerpt from the Proceedings of the Malacological Society, vol. 10, pp. 112-166 in Pt. II, pp. 167-211 in Pt. III, 1912.
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From Dr. George D. Louderback:

Clarke, F. W., A report of work done in the division of chemistry and physics, mainly during the fiscal year 1888-89: U. S. Geol. Survey Bull. 64, 1890.
Diller, J. S., A late volcanic eruption in northern California and its peculiar lava: U. S. Geol. Survey Bull. 79, 1891.
Gooch, F. A., and Whitfield, J. E., Analyses of waters of the Yellowstone Park, with an account of the methods of analysis employed: U. S. Geol. Survey Bull. 47, 1888.
Hague, Arnold, and Iddings, J. P., On the development of crystallization in the igneous rocks of Washoe, Nevada, with notes on the geology of the district: U. S. Geol. Survey Bull. 17, 1885.
Melville, W. H., and Lindgren, Waldemar, Contributions to the mineralogy of the Pacific Coast: U. S. Geol. Survey Bull. 61, 1890.
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U. S. Geol. Survey, Report of work done in the division of chemistry and physics, mainly during the fiscal year 1884-85, U. S. Geol. Survey Bull. 27, 1886.

From Mr. Eldridge D. Drew:

American Association of Petroleum Geologists, Bull., vol. 13, no. 3, March, 1929.
American Petroleum Institute, Drilling and production practice, 1936, American Petroleum Institute, 1937.
Durst, David M., Physiographic features of Cache Creek in Yolo County, California: Univ. of Calif. Publications in Geography, vol. 1, no. 8, pp. 331-372, 1916.
Hinds, Norman E. A., The relative ages of the Hawaiian landscapes: Univ. Calif. Dept. Geol. Sci., Bull., vol. 20, no. 6, pp. 143-260, 1931.
Karajian, Hagop A., Mineral resources of Armenia and Anatolia, Armen Technical Book Co., New York, 1920.
Perrine, C. D., Earthquakes in California in 1895: U. S. Geol. Survey Bull. 147, 1896.
Shaler, N. S., The geology of Nantucket: U. S. Geol. Survey Bull. 53, 1889.

COBALT

Cobalt is a metallic element with physical and chemical properties similar to iron and nickel. When polished it is silver-white with a faint bluish tinge. Cobalt has an atomic weight of 59.84; atomic number 27; melting point 1480°C.; specific gravity 8.9; valence 2, 3, or 4. The compact metal is not attacked by water or oxygen at ordinary temperatures and is thus tarnish-resistant. Cobalt has a hardness of about 5.5 on the Mohs scale and is harder and more tenacious than iron or nickel. Cobalt is strongly magnetic at all temperatures up to 1150°C.

Cobalt is fairly widespread in nature, comprising about 0.001 percent of the earth's crust. It is found as a native element only in meteorites. Cobalt is present in the sun and stellar atmospheres and in nearly all meteorites, together with nickel and iron. Cobalt occurs in sea and mineral waters, soils, and in living plants and animals. Traces of this element have been observed in many metallic ores.

The commercially important cobalt minerals contain cobalt in combination with arsenic, sulfur, and oxygen. Cobalt minerals occur in veins generally found near intrusive igneous rocks and in the residual decomposition products of the weathering of basic igneous rocks. In arsenical minerals cobalt is usually associated with nickel, silver, and gold, whereas in sulfide minerals cobalt generally occurs with copper or iron. Cobalt frequently is obtained as a by-product in the smelting of copper, nickel, silver, lead, and gold ores.

The principal minerals mined for their cobalt content are linnaeite, carrollite, smaltite, cobaltite, erythrite, asbolite, heterogenite, and sphaerocobaltite. Linnaeite is pale, steel-gray cobalt sulfide (Co_3S_4) which tarnishes to a copper-red color. It has a hardness of 5.5 and a specific gravity of 4.8 to 5. Carrollite is a cupriferous linnaeite often containing small amounts of iron and nickel. Smaltite ($CoAs_2$) is a brittle, tin-white to steel-gray mineral, with a metallic luster and a specific gravity of 6.5. It has a hardness of 5.5 to 6, a grayish black streak and an indistinct cleavage. Nickel and iron are usually both present, along with a minor amount of sulfur. If the mineral contains an appreciable amount of nickel arsenide (chloanthite) it is called smaltite-chloanthite to indicate that the species grade into each other. Cobaltite, or cobalt glance (CoAsS), is similar in appearance and physical properties to smaltite. The gray varieties have a violet tinge, whereas the silver-white specimens are tinged with red. Cobaltite has an almost perfect cubic cleavage and is commonly in cubes with striated faces similar to pyrite. Cobalt arsenides of lesser importance are safflorite ($CoAs_2$) and skutterudite ($CoAs_3$).

Erythrite, commonly called cobalt bloom, is a pale crimson to orange-red hydrous cobalt arsenate ($Co_3As_2O_8.8H_2O$) usually found as an oxidation product of cobalt arsenide minerals. Its specific gravity is 3.0 and hardness 1.5 to 2.5. Erythrite most commonly occurs as prismatic crystals and more rarely as earthy incrustations. A black, impure, earthy mixture of manganese and cobalt oxides is called asbolite. The specific gravity of the mineral is about 1.1 and its hardness 1 to 2. Basic igneous rocks (dunites, peridotites) containing cobalt in the form of silicates are concentrated during oxidation to produce asbolite. Heterogenite is a hydrated cobalt oxide, usually containing copper, and occasionally nickel and iron. Another oxidized ore mineral is sphaerocobaltite, a rhombohedral, rose-red cobalt carbonate with a hardness of 3 to 4 and a specific gravity of 4.1.

The principal cobalt-producing areas of the world are located in Africa. Seventy percent of the world's annual production comes from the Katanga district of the Belgian Congo. The other principal producing districts outside North America are Rhodesia, French Morocco, and Kilembe, Uganda. The cobalt and Sudbury districts of Ontario, Canada produce several hundred tons of cobalt yearly. The Bethlehem Steel Company was the only producer of commercial cobalt ore in the United States in 1949. The cobalt is contained in the sulfides that accompany the magnetite mined at Cornwall, Pennsylvania. This ore contains about 0.05 percent cobalt; the pyrite concentrate averaging 1.3 percent cobalt, is roasted for its sulfur content and the calcine is treated chemically to recover the cobalt.

In California some of the copper ores of the foothill copper belt in Mariposa and Madera Counties contain up to 3 percent cobalt, but no commercial production is recorded. A recent survey of a large, low-grade deposit in the Blackbird district of Idaho revealed the presence of over ten million pounds of cobalt. Mine development and exploration is continuing in this area. The Sullivan Mining Company annually recovers several thousand pounds of by-product cobalt at its electrolytic zinc plant in Idaho.

The mining of cobalt varies with the nature of the deposit and the character of the surrounding rocks. The usual mining methods are applied to vein-type deposits and open-pit methods are used when possible. Concentration may be by gravity, magnetic, and flotation processes. The concentrates are smelted to crude cobalt alloy in blast furnaces, reverberatory furnaces, and electric furnaces. Diverse metallurgical operations produce the refined metal or its oxide.

The normal need for cobalt can be supplied for many years by the principal known deposits, so that the development of small domestic deposits probably will not be undertaken in the near future. One of the chief difficulties in developing a domestic deposit is marketing the cobalt ore produced. The price of cobalt ore is not quoted on an open market and it is necessary for the seller to negotiate directly with a prospective buyer. During the war, 10 percent cobalt ore was quoted for delivery, f.o.b., Ontario, Canada, at $1.10 per pound of contained cobalt, and 8 percent cobalt ore was quoted at $ .88 per pound of contained cobalt. The price of cobalt metal (97-99 percent in 500-pound kegs) was quoted on July 6, 1950 by Engineering and Mining Journal Metal and Mineral Markets at $1.80 per pound.

World production of cobalt in 1948 was estimated at 6200 metric tons (approximately 2205 pounds per ton) or about 13,700,000 pounds. The Belgian Congo produced 4,322 metric tons of which about 2,595 metric tons were exported to the United States. Northern Rhodesia's output was 367 metric tons from January 1 to June 30, 1948. The latest production figures available for the United States are for 1946, when 266 metric tons were produced from domestic ore. Current production is estimated to be substantially greater. French Morocco produced 278 metric tons and Canada exported

701 metric tons of cobalt in 1948, but the latter figure includes ore mined in previous years and stockpiled during the war.

The United States is the world's largest user of cobalt. Consumption exceeded five million pounds in 1948, with permanent magnet alloys accounting for 24 percent of the total. Chromium-tungsten-cobalt alloys called stellites constituted 16 percent of the demand. Stellites are hard and corrosion-resistant and are used for high-speed, heavy-duty, high-temperature cutting tools. Cobalt is used as an alloying element in the production of high-speed and other steels and as a binder in the production of cemented carbides. Vitallium, an alloy containing about 65 percent cobalt, 30 percent chromium, and 5 percent molybdenum, is used as a heat-resistant material in gas turbines and jet propulsion engines. Vitallium is also useful as a dental and surgical alloy because it is not attacked by body liquids, does not give rise to any irritation to tissues, and is electrically neutral in the body. "Stainless invar", an alloy containing 36.5 percent iron, 9.5 percent chromium, and 54 percent cobalt, has a coefficient of expansion which is practically zero. By increasing the amounts of iron and chromium slightly, a negative coefficient is obtained.

Cobalt oxide is a necessary ingredient in nearly all porcelain enamel ground coats, which are used to effectively promote the adherence between the enamel and metal. In glass manufacture, cobalt is used to impart a blue color and to decolorize yellow and orange glass. In ceramic materials cobalt produces blue and green colors. Cobalt pigments may be violet, yellow, brown, pink, green, or blue, depending upon the different compounds used. A number of cobalt salts have been found to be excellent driers of paints and varnishes. Although cobalt plating has never attained any commercial importance, the addition of cobalt to nickel for plating purposes has in recent years become widespread. Cobalt compounds act as catalysts in hydrogenation and dehydrogenation processes, desulfurization and oxidation reactions, and as fluorinating agents. Cobalt is a minor but essential element in livestock feed and the majority of investigators incline to the belief that minute quantities are necessary for human [illegible]

REPORTS ON STRATEGIC MINERALS
RECENTLY ISSUED BY THE DIVISION OF MINES

During World War II intensive investigations of strategic mineral deposits in California were made by the United States Geological Survey. Results of these investigations have [illegible] been published by the Division of Mines; some of those available for distribution are listed below.

MANGANESE:	Price
Bull. 125 [illegible] Manganese in California, including outline geologic map of California showing location of manganese properties, scale 1[illegible]000,000	$3.00
Bull. 15[illegible] Geologic description of the manganese deposits of California	2.75

COPPER:	
Bull. [illegible] Copper in California, including separate box of mine maps, and outline geologic map of California showing locations of copper properties, scale 1:1,000,000	6.00

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CHROMITE:

Bull. 134, Part I, Chapt. 1, Chromite deposits of Del Norte County, including topographic map of Del Norte County showing distribution of peridotite and location of chromite deposits	$0.75
Bull. 134, Part II, Chapt. 1, Chromite deposits of the northern Coast Ranges	0.25
Bull. 134, Part III, Chapt. 1, Chromite deposits of Tuolumne and Mariposa Counties	0.35
Bull. 134, Part III, Chapt. 2, Chromite deposits of Calaveras and Amador Counties	0.35
Bull. 134, Part III, Chapt. 3, Chromite deposits of Tulare and eastern Fresno Counties	0.50

IRON:

Bull. 129, Iron resources of California	2.50

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MINERAL INFORMATION SERVICE

VOL. 3 September 1, 1950 No. 9

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

SACRAMENTO OFFICE IN NEW LOCATION

The Sacramento office of the Division of Mines has been moved from its old location on J Street to the third floor of State Office Building 1, located on the State Capitol grounds at Capitol Ave. and Ninth Street directly across from the State Library. A booth is maintained there from which publications and general information may be obtained. A mineral display is being moved into a corridor adjacent to the information booth and library and reading room facilities are being installed. The new office will operate in close cooperation with the Division of Conservation Education of the Department of Natural Resources.

The main technical staff of the Division of Mines and the Division of Mines laboratory are maintained at the San Francisco office. The public is requested to address to the San Francisco office questions of highly technical nature or requests for laboratory examination of specimens.

SEPTEMBER MEETING OF THE MINING BRANCH, SOUTHERN CALIFORNIA SECTION, AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

This meeting will be held in the General Petroleum Bld'g, 612 South Flower St., Los Angeles, at 7:00 p.m., Sept. 6, 1950. It will be primarily a symposium on nonferrous smelter contracts. Mr. Richard Young, Vice President, American Zinc Co. of Illinois, Mr. B. L. Sackett, Metallurgical Manager, Tooele Plant, International Smelting and Refining Co., and one other prominent smelter representative will be the speakers. The meeting is open to all interested parties.

NEW PUBLICATIONS OF THE DIVISION OF MINES

Mineral Commodities of California

Bulletin 156, Mineral Deposits of California, Geologic Occurrence, Economic Development, and Utilization of the State's Mineral Resources, is the most comprehensive work on California economic mineral deposits ever attempted by the Division. We are exceedingly pleased to have just received in page proof two copies of this bulletin. Their receipt is most timely as there has been an unprecedented demand for information of this sort because of the present war emergency. Although copies are not yet available for distribution, the public is invited to use the two copies of page proof until such time as bound copies are available. One will be open for inspection at the Los Angeles office (Room 400, State Building) and the other at the San Francisco main office (Ferry Building, mezzanine floor).

California Journal of Mines and Geology

California Journal of Mines and Geology, Vol. 46, No. 3, July 1950, is now being distributed. This issue contains "Needles Magnesite Deposit, San Bernardino County, California", by Charles J. Vitaliano, U. S. Geological Survey; "Northern California as a Market for Chemicals", by E. William Eipper and the Western Chemical Market Research Group; "Skaggs Springs Quicksilver Mine, Sonoma County, California", by Donald L. Everhart, U. S. Geological Survey; "The Altoona Quicksilver Mine, Trinity County", by C. Melvin Swinney, U. S. Geological Survey; "Health and Safety Work of the Bureau of Mines", by James Boyd, Director, U. S. Bureau of Mines; and "Mines and Mineral Resources of Yolo County", by J. C. O'Brien, District Mining Engineer, State Division of Mines.

STRATEGIC MINERALS IN CALIFORNIA AND THE STOCKPILING PROGRAM

Owing to the current unsettled international situation, attention is again being focused on the procurement of materials which would be essential to vigorous promulgation of major military operations. As many mineral deposits of this nature are present in California, various state and municipal agencies are offering the Federal Government immediate cooperation in procuring essential materials for emergency use.

Governor Warren on August 1 sent the following telegram to Secretary of the Interior Chapman:

"Anticipating possible shortage of war materials and necessity Federal Government encouraging maximum domestic production in existing emergency, California offers full cooperation of its Division of Mines which, in cooperation with your agencies, has compiled and published strategic minerals investigations conducted during last war. Suggest for consideration organization local boards of representatives Geological Survey, Bureau of Mines, and State Division of Mines and of informed members local mining industry to determine location most promising sources of specific minerals needed and facilities for production and other functions to assist meeting requirements promptly."

(Signed, EARL WARREN)

During the last few years, the Division of Mines has published many works on California minerals essential to wartime economy and its staff members are presently engaged in research for many others. Postwar publications on various essential minerals include Bull. 129, Iron Resources of California; Bull. 144, Copper in California; Bull. 152, Manganese in California; and the various parts of Bull. 134, Geological Investigations of Chromite in California. In addition to these comprehensive works on California metals, shorter articles have appeared in the California Journal of Mines and Geology. In postwar issues of the Journal most of the quicksilver districts have been covered and a great many tungsten and other miscellaneous mineral deposits have been written up. A complete price list of available publications appeared in the July issue of Mineral Information Service.

At the present time staff members of the Division are working on mineral commodities of a strategic or essential nature. These include talc, fluorspar, and kyanite. The cooperative program between the U. S. Geological Survey and the Division of Mines which made possible publication of a great many of the aforelisted works is still in effect, and studies of other quicksilver, lead, zinc, copper, magnesite, and tungsten deposits are nearing completion by the U. S. Geological Survey staff.

The State Division of Mines also cooperates with the U. S. Bureau of Mines in gathering and publishing annual statistical data on California mineral production. The figures so compiled are of inestimable value both to war and to civilian mineral procurement planning.

As early as 1938 problems of creation of stockpiles of scarce raw materials were being studied by the Munitions Board and other Federal agencies, and stockpiling was being urged by the mining industry itself. Congressional authorization and appropriations were granted in 1939, but the stockpiling program did not get well under way until June 1940, at which time the Metal Reserves Company was created and adequately financed. The stockpile program functioned with varying degrees of success through the war years, but declined materially during the postwar period. Now, under pressure from many sources, the program is being revived and reexamined. The latest Munitions Board list of strategic and critical materials, dated July 26, 1950, includes the following mineral substances which may be acquired through purchase or by transfer of Government-owned surpluses as provided in sections 3(a) and 6(a) of Public Law 520, 79th Congress:

- Aluminum
- Antimony
- Asbestos
  - Amosite
  - Chrysotile
  - Crocidolite
- Bauxite
  - Metal grade
  - Abrasive grade
- Beryl
- Bismuth
- Celestite
- Chromite
  - Chemical grade
  - Metallurgical grade
  - Refractory grade
- Cobalt
- Columbite
- Copper
- Corundum
- Diamonds (industrial)
- Iridium
- Platinum
- Quartz crystals
- Sapphire and ruby
- Talc
  - Steatite
  - Block
- Graphite
  - Amorphous lump
  - Crystalline flake
  - Crucible grade
  - Lubricant grade
- Iodine
- Kyanite
- Lead
- Manganese ore
  - Battery grade
  - Chemical grade
  - Metallurgical grade
- Mercury
- Mica
  - Muscovite block, good stained, and better
  - Muscovite film
  - Muscovite splittings
  - Phlogopite splittings
- Monazite
- Nickel
- Platinum group metals
- Tantalite
- Tin
- Tungsten
- Vanadium
- Zinc

Potential producers of any of the above items should write the Federal Supply Service of the General Services Administration for specifications and for instructions as to how their product can be acquired by the stockpile. Additional information on the present status of the Federal stockpile may be obtained from the most recent Stockpile Report to the Congress prepared by the Munition Board and obtainable from the U. S. Bureau of Mines, Washington, D. C. Policies and procedures relating to procurement are subject to rapid change and the State Division of Mines has had no recent marketing information from the General Services Administration. Please address the G. S. A. for information as follows:

H. C. Maull Jr., Chief, Purchasing Section, Strategic and Critical Mineral Division, Federal Supply Services, General Services Administration, 7th and D St., S. W., Washington 25, D. C.

INSTITUTION OF MINING AND METALLURGY ABSTRACTS

The Institution of Mining and Metallurgy, a British organization, has commenced publication of monthly abstracts on world literature pertaining to economic geology, mining, mineral dressing, extraction metallurgy, and allied subjects. Annual subject and author indexes will be issued.

For the time being, I.M.M. Abstracts will be published as a part of Bulletins of the Institution and will be issued free to members and subscribers. The first abstracts appear in the July issue of the Bulletin. Subscription rate for the Bulletin, published monthly, is three pounds per year. Communications should be addressed to Institution of Mining and Metallurgy, Salisbury House, Finsbury Circus, London E.C. 2.

CALIFORNIA TOPOGRAPHIC MAPS

The topographic Mapping Section of the U. S. Geological Survey has announced that the following topographic maps of areas in California recently have become available. Copies may be secured from local distributing agencies or from the U. S. Geological Survey, Denver Federal Center, Denver 15, Colorado, at a cost of 20 cents each.

Location of S. E. Corner						
Latitude		Longitude				Contour Interval
Deg.	Min.	Deg.	Min.	Name	Scale	in feet
33	15	116	52½	Boucher Hill	1:24000	40
38	45	120	52½	Coloma (formerly Lotus)	1:24000	40
38	30	120	45	Fiddletown (formerly Logtown Ridge)	1:24000	40
36	15	119	22½	Goshen	1:24000	5
38	30	120	52½	Latrobe	1:24000	40
36	22½	119	15	Monson	1:24000	5
39	15	121	07½	Nevada City	1:24000	25
36	37½	119	15	Orange Cove North (formerly Citrus Cove)	1:24000	25
39	37½	121	52½	Ord Ferry (formerly Chico Landing)	1:24000	5
39	15	121	15	Oregon House	1:24000	25
34	10	114	05	Parker Dam Area (Calif. portion only)	1:62500	40
33	15	117	00	Pala	1:24000	20
39	22½	121	15	Rackerby	1:24000	25
32	57½	118	30	San Clemente North	1:24000	25
32	47½	118	20	San Clemente South	1:24000	25
37	45	122	22½	San Francisco North	1:24000	25
37	37½	122	22½	San Francisco South	1:24000	25
35	30	117	15	Searles Lake	1:62500	40
36	22½	119	22½	Traver	1:24000	5
34	00	118	52½	Triunfo Pass	1:24000	25
36	15	119	15	Visalia	1:24000	5
36	37½	119	22½	Wahtoke	1:24000	25-5

PLEASE NOTE: THE FOLLOWING MAPS ANNOUNCED FOR SALE IN THE JULY 1950 MIS ARE NOW OUT OF PRINT: LOS ANGELES COUNTY, INYO COUNTY, SAN BERNARDINO COUNTY, TUOLUMNE COUNTY, AND SAN DIEGO COUNTY.

MINING AND INDUSTRIAL NEWS NOTES

Barite in Mariposa County

A new barite ore-body has been discovered in the old barite mining district near El Portal, Mariposa County. The new find was made during diamond drilling operations carried on last winter. Recent development work includes driving of a crosscut and raise on the lens-shaped ore-body. It is one of three parallel veins which strike north-south and dip 85° west. The El Portal mines have produced barite and witherite intermittently for more than 70 years. The present operator is the Baroid Sales Division of National Lead Co.

Marble Springs Mine, Mariposa County

The Marble Springs mine located 15 miles east of Coulterville road began operating late in 1949 after a lapse of 12 years. Mining is progressing on the 400-foot level with 8 men employed. Values occur both as free gold and in gold-bearing pyrite in a quartz gangue. Ore is put through a primary jaw crusher and rod mill and then is jigged and floated. Concentrates are shipped to Selby for smelting. C. G. Glenn and Arthur Steintorf are the present lessees and R. Jergentz is superintendent.

New Drift Mine in Nevada County

The Howie drift mine, located on the old Snowpoint mine property in northern Nevada County, began washing operations early in June. A vertical two-compartment shaft has been sunk to bedrock at a depth of 230 feet, and about 400 feet of drift excavated. All equipment is new. Twelve men are employed, and an output of approximately 100 cubic yards per day is expected in the near future. Mr. Robert Hodge is president and Ross Prout general manager of the company.

Placer Exploration in Trinity County

Gravel deposits on the west banks of the Trinity River near Carrville, Trinity County, are being drilled and sampled for a possible dredging operation. Four men operating a Keystone churn drill have completed 12 holes 40 to 70 feet deep in the six weeks period beginning June 1. The deposits include some boulders and cemented sand.

ASBESTOS

Small quantities of asbestos, one of the strategic mineral materials in which the United States is deficient, have been intermittently produced in California for many years. Massive serpentine, the host rock for most asbestos deposits, is widely distributed throughout California and in the future may yield asbestos from hitherto undiscovered deposits.

Of the group of fibrous minerals known as "asbestos", chrysotile ($H_4Mg_3Si_2O_9$), a variety of serpentine, accounts for about 96 percent of the world's production. Chrysotile fibers are silky and flexible and have high tensile strength; when sufficiently long they are valued for spinning. Chrysotile is less resistant to heat and acid than most other asbestos varieties.

The classification "amphibole asbestos" includes the fibrous minerals anthophyllite ($(Mg,Fe)SiO_3$), tremolite ($CaMg_3(SiO_3)_4$), actinolite ($Ca(Mg,Fe)_3(SiO_3)_4$), crocidolite ($NaFe(SiO_3)_2FeSiO_3$), and amosite, an amphibole more iron-rich than anthophyllite. Crocidolite and amosite are commonly suitable for spinning. Anthophyllite and tremolite are most valued for their resistance to acids. California's asbestos production has been almost entirely of the chrysotile and tremolite varieties.

The chrysotile and tremolite deposits of California, like the large deposits in Quebec, are contained mostly in massive serpentine formed from the alteration of magnesium rich ultra-basic rocks. The asbestos occurs in veins and veinlets in parallel or net-like arrangement. The value of a deposit is determined largely by the extent, width, and the closeness of spacing of the veins.

Asbestos mineral in the veins may occur as 1) cross-fiber, where the fibers are perpendicular to the vein walls, 2) slip-fiber where the fibers parallel the walls, and 3) mass fibers with no discernible orientation. Though asbestos has been noted at many places in the large serpentine belts of California, at relatively few localities do concentrations exceed 5 percent, the grade above which deposits are considered to be of commercial interest.

The potential asbestos-bearing rocks, serpentine and its associated basic intrusives, are widely distributed in all the counties of the Coast Ranges, the Klamath Mountains, and in the western foothills of the Sierra Nevada. Asbestos deposits also may occur apart from serpentine masses. Commercial chrysotile bodies in Arizona, for example, are in dolomitic limestone and are associated with diabase sills. Metamorphic rocks of various types are known to contain amphibole asbestos.

Asbestos has been produced and sold intermittently in small quantities in California since 1882. Although 15 counties have reported asbestos production and 17 additional counties have reported occurrences of asbestos since that date, no consistent production has been developed at any point in the state.

A chrysotile deposit seven miles southeast of Copperopolis, Calaveras County, was one of the first to be systematically developed. Work began in 1904 and continued intermittently until 1923. Equipment included a crusher, hammer mill and compressor. A small tonnage of fiber was produced and used in acoustical and fireproof plaster. Further experimental work was done in 1927.

A short-fiber chrysotile was produced in small quantities between 1917 and 1923 from a serpentine area near Washington, Nevada County. The rock was mined in an open pit and crushed in a 20-stamp mill equipped with air-suction and fiberizers. The stamps were later replaced by crushing rolls.

Chrysotile in a serpentine belt on the southwest slope of Sampson Peak near Hernandez, San Benito County, was mined by hand methods between 1921 and 1925. The crude ore was run through a mill consisting of a crusher and some air-suction equipment. No dryer was included in the flow sheet, and the property was worked only during the dry season.

A small production of chrysotile from Monterey County and amphibole from Riverside County was reported in 1930. These were used for test purposes and as packing in the manufacture of automobile battery boxes, respectively.

Chrysotile produced in Napa County during 1933 and 1934 was used for test purposes and for experiments in mill design. Short-fiber chrysotile was obtained from a deposit in Steel Canyon, Napa County, from 1941 to 1945. The ore was mined from an open cut. The mill consisted of a jaw-crusher, rotary dryer, two cyclones, shaking screens, two disintegrators, and a bagger. The product was used in plaster and stucco for fireproofing war-plant buildings.

Small lenses and pockets of tremolite in peridotite at Mears Creek in the northwestern corner of Shasta County have been mined, and shipped from 1942 to the present.

This fiber after hand sorting and shipping is processed by the Powhatan Mining Company and made into acid filter pads for the Gooch crucibles used in chemical laboratories.

A vein of white slip-fiber tremolite is found near Iowa Hill, Placer County, at the serpentine-slate bed-rock contact in the old hydraulic mine workings. The vein ranges from 6 to 15 feet in width and fibers eight inches long have been reported. A small production of these fibers for use in acid filters has been reported from 1942 to the present.

Asbestos is of two commercial classes; spinning and non-spinning fiber. The long, strong, flexible fibers are spun into yarn, which is woven into heat-resisting fabrics such as brake linings, tape, and cloth. Chrysotile is best adapted to this use, although the better grades of crocidolite, amosite, and sometimes tremolite can also be used. Some of the longer grades are used in magnesia block and pipe insulation consisting of 85 percent magnesia and 12 percent asbestos. Here, as well as in cements, plasters, and molded articles, the asbestos acts as a binder.

The shorter non-spinning grades are made into shingles, siding and paper. The use of asbestos-cement pipe for gas, sewer, and water mains is increasing as it is resistant to acid and corrosion, and is non-conductive, and shock-proof. The fiber waste or shorts are used in making asbestos plaster, flooring, and as fillers in grease and paint. The best grades of tremolite and anthophyllite are acid-resistant and are used as filters in chemical laboratories. The low-iron variety of chrysotile found in Arizona is valuable in making electrical insulation tapes. Many new uses and adaptations for asbestos fibers are constantly being developed in the insulation and other industries. A typical example is the use of spray-coated insulation for metal, concrete, wood, and other surfaces.

Because large commercial deposits of asbestos, such as those in Quebec, usually cover extensive areas and the fiber content of the host rock averages only from five to ten percent, open cut large tonnage operations are almost always employed in the early stages of development. The rock is blasted, loaded with power shovels, and trucked to the recovery plant. At a later period in the life of a property underground mining methods may be introduced. Both shrinkage-stope and block-caving methods have been successfully used for final stage operations in the Canadian mines.

Milling consists of separating the fiber from the barren rock by repetitive crushing, screening, and air-suction. A typical mill flow sheet would include primary and secondary rock crushing to a 3-inch size, furnace drying to remove moisture, and third-stage crushing to free the fiber. The third stage crushing product, about $\frac{1}{2}$-inch size, flows to a longitudinal shaking screen. While proceeding along the screen a gravity concentration occurs, producing a layer of light-weight fiber on top and a layer of heavier rock on the bottom. The light-weight fiber is removed through a suction hood installed at the end of the screen. The oversize is crushed to $\frac{1}{4}$-inch size and rescreened as outlined above. The undersize is fed to a fiberizer, consisting of high-speed hammers which break the rock by impact, making a further separation of rock and short fibers. The latter are separated by another suction-screening operation. When free, the fiber is passed to a two-level screen for size classification. The shorts drop through both screens, the medium-length fiber is removed by air-suction from the end of the lower screen, and the long fiber is similarly removed at the end of the top screen.

In 1948 high-grade Canadian crudes and spinning fibers commanded an average price of $609 per short ton. Only one-tenth of one percent of the Canadian production was placed in this classification. An intermediate grade of Canadian fibers used in shingles and sheeting averaged $107 per short ton. About 34 percent of the production was in this

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category. Short fibers averaged $33 per ton, according to the Department of Mines, Province of Quebec, Canada. The majority of the production, 66 percent, fell in this class. The price paid for amphibole asbestos produced in California in 1948 ranged from $50 to $200 per short ton, depending on iron content and ignition loss. There was no production of California chrysotile in 1948.

PUBLICATIONS ON MINING LAW

For persons interested in the legal aspects of mining, the Division of Mines has issued several pertinent publications, which are listed below.

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Olaf P. Jenkins, Chief
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MINERAL INFORMATION SERVICE

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IN MEMORIAM

CHARLES V. AVERILL

Charles Volney Averill, mining engineer for the California State Division of Mines for more than 20 years, passed away in San Francisco, August 28, after a brief illness. His passing has been keenly felt by those associated with him at the Division of Mines where he will be remembered as a great engineer, a great technical author, and above all a cherished friend.

Born at Virginia City, Nevada, the son of District Judge Mark R. Averill, and brought up in mining camps, Charles V. Averill was exposed to and identified with mining activities most of his life. He graduated with honors from the University of California College of Mining, receiving the degree of Bachelor of Science in 1914. His early work was as a surveyor, mining engineer, and geologist with various Nevada mining companies. He was with the Tonopah Extension Mining Company, at Tonopah, Nevada, from 1918 to 1926, and then moved to Richmond, California where he spent two years as a mechanical engineer for Standard Oil Company.

In 1928, Mr. Averill joined the mining engineering staff of the California State Division of Mines and shortly was made District Mining Engineer. In that capacity he served at the Redding, Sacramento, and San Francisco offices before being made Supervising Mining Engineer in 1947. Since that time he had been stationed at San Francisco in charge of Division of Mines engineering work throughout the state. The long list of works written by Mr. Averill covered nearly all phases of mining and geological activity in California, and he has been listed in Who's Who in Engineering for many years. He was a member of the American Institute of Mining and Metallurgical Engineers and various other organizations connected with the mining industry.

MINING AND INDUSTRIAL NEWS NOTES

New Jade Occurrence in California

Jadeite and nephrite jade recently have been found associated together in stream boulders from the North Fork of the Eel River, Trinity County. The find was made by geologists of the Tidewater Associated Oil Company and confirmed by members of the California Division of Mines and California Academy of Sciences. The jadeite is light mottled green and gray and does not resemble the San Benito County material; associated nephrite is dark green. Boulders of jasper and crocidolite are found with the jade and are from the same source rocks; none of the material, however, has been found in place. The crocidolite is not easily recognized on weathered surfaces because of iron oxide alteration products.

A more complete report on California jade is being prepared for publication by the Division of Mines by H. S. Yoder, Jr., National Geophysical Laboratory, George Switzer, U. S. National Museum, and C. W. Chesterman, State Division of Mines.

SOURCES OF INFORMATION ON STRATEGIC MINERALS

To facilitate public use of published information relating to minerals now on the Federal stockpile critical and strategic mineral list, the Division of Mines has compiled tables of selected references pertaining to such minerals with special emphasis on their California occurrence. Table I lists general references which treat with a wide variety of minerals. Table II lists specific minerals with references and comments on each. Books in Table I were selected on the basis of their completeness and date of issue (or revision) or because of their special content.

GENERAL REFERENCES - TABLE I

1. American Mining Congress Bull. Service - Bi-weekly pamphlet.
2. Economic Geology, Ries, Heinrich et al, 7th ed., John Wiley and Sons, Inc., 1937.
3. Engineering and Mining Jour. Metal and Mineral Markets - weekly pamphlet on marketing.
4. Industrial Minerals and Rocks, 2nd ed., A.I.M.E., 1949.
5. Mineral Commodities of California, Geologic occurrence, economic development and utilization of the State's mineral resources, Calif. Div. Mines Bull. 156, 1950.
6. Mineral Information Service - monthly pamphlet, Calif. Div. Mines.
7. Mineral Resources of the United States, Public Affairs Press, 1948.
8. Minerals in World Affairs, Lovering, T. S., Prentice-Hall Book Co., N. Y., 1943.
9. Minerals Yearbook, U. S. Bur. Mines, 1948. Annual statistical publication.
10. Strategic Mineral Supplies, Roush, G. A., N. Y., McGraw-Hill Book Co., 1947.
11. Strategic Minerals, De Mille, J. B., N. Y., McGraw-Hill Book Co., 1947.
12. Strategic Minerals in California, Merrill, C. W., Calif. Div. Mines Rept. 34, 1938.
13. Stockpile Report to Congress, U. S. Munitions Board, July 1950.
14. Western Economic Empire, Industrial West Foundation, San Francisco, 1944.
15. World Minerals and World Peace, Leith, C. K. et al, Brookings Institution, Washington, D. C., 1943.

REFERENCES BY MINERAL--TABLE 2

The following abbreviations are used in this table: B--Bulletin; IC--Information Circular; JMG--California Journal of Mines and Geology; M--California Division of Mines Map; MIS--Mineral Information Service; MY--Minerals Yearbook; Pre--Preprint; PP--Professional Paper; RI--Report of Investigations; RM--Report of the State Mineralogist. Volume numbers are given for all periodicals; issue numbers and page references where necessary. Numbers in parentheses in column marked "Other" apply to reference list on page 2. The numbers following those in parentheses are page references.

Mineral Product	Cal. Div. Mines	U.S.Geol.Surv.	U.S.Bur.Mines	Other	Remarks
Aluminum and Bauxite	B 99:354-55			Geol. Soc. America B 52:271,294 Univ. Calif. Dept. Geol., B 18:347-489 (3):95-118; (4):285-88; (6):63-71; (7):279-91; (8):116-27, 176-87; (9):200-37; (10):30-48, 78-85; (13): IIC 52-58	Two sources of aluminum metal currently utilized: bauxite ore and reclaimed scrap. Possible future sources: bauxite and other high-aluminum clays and calcic feldspars. Methods recently devised for extraction of metal from such sources. California has reserves of clay and feldspars in Sierran foothills, W. side of Sacramento Valley and San Gabriel Mts.
Antimony	MIS 1:5, 5 B 147:37-56	B 931q:405 B 922k:307		(4):288-91; (6):52-56; (7):341-48; (8):128-36; (9):238-73; (10):49-55; (13):IIC 7-11	Produced from sulfide ore and reclaimed scrap alloys. Small California production, past and present, from Mojave Desert and basin ranges. Stayton district, N.E. San Benito County, has proved reserves.
Asbestos	MIS 3:9		B 403:1-92	Asbestos 27:3,4,5; Geol. Soc. S. Africa, Proc. 48: 161-207. (3):55-76; (4):121-24; (8):144-55; (10):66-71	Includes several flexible-fibered mineral varieties, principally chrysotile, crocidolite, tremolite, and anthophyllite (amosite). Principal varieties occur in California, esp. in W Sierra Nevada and Coast Ranges. Most California deposits smaller or lower in grade than Canadian sources currently supplying U.S. Small irregular production from California; potentialities not known. Div. Mines making survey.
Beryl and Beryllium	MIS 1:10		IC 6190 IC 7327	Atomic Energy Comm. Doc. 1851 (4):132-33; (8) :1311-18; (10):86-91; (13):IIC 12-13	Beryl (beryllium aluminum silicate) only commercial source beryllium, occurs in California pegmatites but not in commercial quantities as yet except as occasional gem stones.
Bismuth	MIS 2:3		IC 6460	Eng. and Min. Jour. 149: No.2,87 (4):291-93; (6):72-73; (8):188-03; (10):92-96; (13):IIC 13-14	Produced in U.S. almost wholly as by-product copper and lead ores or imported bullion. None currently produced in California, but Bismuth-bearing copper ores occur in Sierran foothill copper belt.
Celestite			Econ. Pap. 4	Geol. Soc. America B 58:1250; Am. Inst. Min. Eng. Trans. 115:357-62; (3):980-88; (4):270-73; (8); 1366-67; (10):454-58;	Occurs California largely in folded Tertiary lake-beds of San Bernardino and Imperial Counties. Celestite is the main source of strontium; California deposits could supply entire U.S. demand.
Chromite	RM 38:73 B 134 MIS 2:11 M 3	B 922o,B 922j B 936d,B 945a, B 945b	IC 6506	Eng. and Min. Jour. 150:2, 91 (3): 194-206; (4):294-98; (6):77-81; (7): 220-232; (8):244-53; (9):97-129; (10):117-27; (13):IIC 15-23	Principal source chromium. Widely distributed in California; produced some during war. Calif. deposits low-grade , though some may be exploited by new beneficiation and electrolytic-refining methods.
Cobalt	RM 21:142 MIS 1:9		IC 6331	American Chem. Soc. Mono. 108 (4):299-300; (6):89-92; (8):397-408; (10):128-33; (13):IIC 24-25	Not produced in California, although copper ores of Sierran foothills contain cobalt which might be recovered in emergency. Occurs as sulfo-salt ores in other states; recovered as a by-product.
Columbite	B 136:117		IC 6328	(6):191; (8):1327-30; (10):134-37, 477-81	Blackish rare-earth mineral from which columbium, tantalum, etc. are obtained. Found in isolated crystals from many places in California. None of the occurrences described as having abundant material; probably not economic. California occurrences in pegmatites and veins.
Copper	B 144 RM 43:105-62 RM 20:434-37 JMG 37:295-96 MIS 1:3			Econ. Geol. 25:25-35; Econ. Geol. 44:1-82; (4):300-08; (6):93-99; (7):263-78; (8):473-506, 1418-45; (10):138-65; (13):IIC 26-40	More than 600,000 tons of copper produced in California since 1861. Large reserves of low-grade ore in Shasta, Plumas, and Calaveras Counties; significant reserves in many other counties. California copper deposits are mainly veins, veinlet stockworks, or irregular replacement bodies near igneous contacts.

REFERENCES BY MINERAL--TABLE 2--CONT'D.

Mineral Product	Cal. Div. Mines	U.S. Geol. Surv.	U.S.Bur. Mines	Other	Remarks
Corundum			IC 6471	Univ. Cal. Dept. Geol., B 3-219-229 Geol. Soc. Am. B 21:793; (3):10-24 (8): 109-11; (10):166-72, 183-85	Natural oxide of aluminum used as abrasive and for jewels and jewel bearings. Found in California but no deposits as yet developed; occurs here in dike rocks or at syenite contacts.
Diamond	B 136:129-32		IC 6562	(3):9-10; (6):100; (8):111-12; (10):176--82;	U.S. wholly dependent upon imports from Africa and South America for industrial diamonds. Few diamonds found in California placers but total weight small. No California diamonds used for abrasive purposes.
Graphite	RM 33:245-48		IC 6118	Econ. Geol. 29:346-55; (3):417-35, 785; (4):169-70; (6):110; (8):1351-58; (10):201-07	Several deposits of potential economic importance in California have been mined in past, and might become important in wartime. More than 1,500,000 pounds produced in L.A. county in 1918-31; other deposits in San Gabriel Range and Sonoma and Mendocino Counties. California deposits in schist and gneiss.
Iodine	MIS 2:9			Ind. and Eng. Chem. 41:1547-1552; Armstrong and Miall, Raw materials from the sea, 112-113; (3):611-14; (4):230-33; (8):1070-71; (9):377-95; (10):210-11	California supplies nearly half U.S. requirements; production could be expanded to produce all U.S. requirements. Oil well brines furnish present Calif. production; formerly produced from Calif. seaweed.
Kyanite	RM 27:459-64		IC 6255	Econ. Geol. 27:614-93; (3):905-06; (4):116-18; (8):1356-58; (10):245-49	Blue aluminum silicate, mined at Ogilby, Imperial County before 1948. California product inferior to Indian kyanite, but domestic deposit a potential source. Technologically similar andalusite found in commercial amounts in White Mtns. of Inyo County.
Lead	B 144:161-97		IC 6314	Am. Inst. Min. Eng., Tech. Pub. 2407; Econ. Geol. 44:82; (4):319-24; (6):121, (7) :293-306; (8):702-21; (10):250-69; (13):IIC 52-58	Produced from many parts of California in past; Darwin and Tecopa districts currently most important. Recoverable as by-product gold, copper, or zinc ores, Klamath Mtns. and Sierran foothills. Many small and medium-sized copper-lead-zinc or silver-lead-zinc deposits could produce material quantities.
Manganese	B 125 B 152 MIS 3:2 M 5		IC 6770 IC 6771 IC 6772	(3): 542-50; (4):324-30; (6):130-33; (7):206-19; (8):764-84; (9):31-69; (10):298-313; (13):IIC 60-73	Many small, low-grade California deposits might be important in wartime. Processes for electrolytic and chemical extraction from low-grade ore perfected; may cause some poor ore to be economically important. Deposits in Coast Ranges and Sierran foothills.
Mercury	B 78 RM 26:59-63 RM 38:223-42 RM 39:99-100 RM 41:11-35,65-89 RM 42:81-124, 197-230 JMG 43:9-14 JMG 44:253-277, 327-334 JMG 46:385-404 MIS 1:7 (Ref.) M 1	B 922b, 931b. 931q, 936d, 936f, 936q, 922l		(4):330-37; (6):134-38; (7):333-40 (8):785-800; (9):274-304; (10):314-25; (13):IIC 52-58	California nation's principal source domestic mercury; production 89% of domestic total. Many remaining California reserves low-grade; exploitable only during high prices. Some high-grade ore present at New Almaden and other mines now idle. Nearly all mines in Coast Ranges.
Mica	B 38:337-38	B 740	IC 7258	(3):551-66; (4):184-86; (6):139-42; (8):801-14; (9):339-76; (10):326-38	Some grades muscovite produced in California from mica schists and pegmatites; occurrences numerous but mostly scrap grade not urgently needed by stockpile at present. Small amounts of higher grade might be selected from pegmatites, San Diego County.

Monazite	MIS 2:8		IC 6321	Econ. Geol. 45:no.4; Eng. and Min. Jour. 149: no. 9, 75-77; Metals Progress 53: no. 4, 515-20, Am. Inst. Min. Eng. Tech. Pub. 2460; (3):629-36; (4):361-64; (8):1363-64; (10):349-54	Yellowish-brown phosphate of rare-earth metals and imported source of fissionable materials. Minor constituent of many Calif. igneous rocks and placer black sands; No production yet recorded. Small amounts might be concentrated from black sands of dredge operations.
Nickel	MIS 1:11, 5-6 JMG 42:15-29	B 640d	MY Pre. 1949	(6):152-55; (7):232-38; (8):882-92 (9):70-96; (10):355-67; (13):IIC 86-88	Nickel-bearing areas known in California; no commercial production to date. In 1949, U.S. produced about 5% of its nickel requirements, most of the remainder coming from Canada.
Platinum group metals	B 85	B 694	IC 6389	(4):340:43; (6):170-72; (8):1041-51 (9):305-38; (10):381-402, 416-18, 421-23; (13):IIC 88-90	Platinum group metals mined in California since 1850, but state furnished only small part of U.S. consumption. Output Calif. recovered from placer deposits dredged for gold.
Quartz crystal	RM 40:423-33 MIS 2:12, 2-4			Am. Mineralogist 30: nos. 5 & 6. (3):766-73; (4):206-08; (8):1365-66 (10):410-16	Most of world's supply from Brazil. A few hundred pounds has been produced in California, and possible deposits might be mined if need were acute. Principal California source has been Calaveras County.
Rutile	B 129:245-66		IC 6386	(3):1042-73; (8):1234-48; (10):501-10;	Domestic production of rutile (titanium oxide) mostly from Arkansas; California has not produced rutile, nor are there extensive known deposits. Titanium could be produced from titaniferous magnetite of San Gabriel Mountains.
Sapphire and Ruby	RM 34:34-78			Kraus and Slawson, Gems and gem materials, 65-68; (3):742-43; (8):573-74; (10):419-20, 424-26	These gems are used as bearings in scientific instruments. State has small quantities in Plumas and San Bernardino County metamorphic rocks; presence of workable deposits doubtful. See also corundum.
Talc	MIS [illegible]:5, 5-6			Min. Eng. 187:1, 122-28; Min. and Ind. News 16:1, 12; (3):1018-41; (4):275-82; (8):1197-1206; (10):468-500	California one of foremost talc-producing states; principal steatite-grade producer in U.S. Mining districts in Inyo County, Sierran foothills and Northern San Bernardino County.
Tin	RM 37: 531-57 RM 42:31-52	B 620p:351-54	RI 3876	(4):349-52; (6):193-94; (7):319-32; (8): 1207-33; (9):162-99; (10):482-500; (13):IIC 118-20	U.S. tin requirements supplied by foreign sources. California tin occurrences very low-grade; small amounts mined in past. Principal districts in Riverside, Kern, and San Bernardino Counties. Deposits in tourmaline quartz veins or tactite replacements.
Tungsten	RM 37:225-326 MIS 3:6, 1-3 RM 41:231-249 JMG 46:23-42 M 4	B 922h,q,s B 931e	RI 4627	(4):355-61; (6):198-202; (7):239-48 (8):1249-61; (9):130-61; (10):513-24; (13):IIC 123-30	California tungsten mined from placer and vein deposits in San Bernardino and Inyo Counties. California leading 1948 domestic producer, contributing nearly 45% of nations total, about 18% of consumption. California reserves are large.
Vanadium	JMG 43:101-04			Colo. Sch. Mines Quart. 38:no 4; (6):203-05; (7):256-61; (8): 1279-82; (10):546-54; (13):IIC 130-32	California has produced none to date; vanadates found in Kern and San Bernardino Counties; some gold-bearing quartz veins of Amador and Calaveras Counties contain vanadium mica.
Zinc	MIS 1:12, 5-6 B 144:161-196	B 540b PP 110		(4):364-68; (6):206-12; (7):307-18 (8):1283-1309, 1418-45; (10):555-76 (13):IIC 52-58	Zinc produced in California from Sierran foothills and E Mojave desert; normal production small part of nation's requirements. New techniques for refining complex ores may allow greatly increased production.
Zirconium	MIS 3:3, 7-9		IC 6455 IC 6456	Chem. Ind. 65:5, 728-30; Jour. Metals 1:7, 6-9; (3):784-85; (4):368-70; (8):1345-50; (10):577-82	Zircon only domestic source-mineral of zirconium; occurs in black sand concentrates from California gold dredging operations; commercial production to date very small and great increase unlikely.

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MINERAL COMMODITIES OF CALIFORNIA

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Bulletin 156, Mineral Commodities of California, is now ready for distribution. This volume reviews, by means of separate technical papers, the entire mineral industry of California. More than 80 different kinds of raw mineral materials are discussed, nearly all of which, under favorable economic conditions, are capable of profitable development and use in industry. Also included is a map showing the general distribution of mineral deposits, on the back of which are description and map of the geomorphic provinces of the State.

The entire technical staff of the Division of Mines has assisted in the preparation of this volume; eighteen are actual authors of articles. The latest statistical data were supplied through cooperative agreement by the U. S. Bureau of Mines; the earlier production figures were drawn largely from the Division's own records, and recast in the form of graphs.

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MINERAL INFORMATION SERVICE

Vol. 3 November 1, 1950 No. 11

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

U. S. DEPARTMENT OF INTERIOR MINERALS AND ENERGY ADMINISTRATION

In order to administer the responsibilities delegated to the Department of the Interior under the Defense Production Act of 1950 (Public Law 774), a new Minerals and Energy Administration has been organized. Secretary of the Interior Oscar L. Chapman will be Administrator and the organization will consist of four industry agencies embracing electric power, petroleum and gas, solid fuels, and metals and minerals. Functions of the agencies will be to: expand and maintain the supply of raw materials or services for which the divisions have responsibility; prepare estimated requirements for equipment, supplies, transportation and storage facilities, and manpower required for the supply programs; distribute the resources under their jurisdiction consistently with allocation and priority determinations; assure maximum use and conservation of productive resources used by industries under the jurisdiction of these divisions; initiate proposals under Title III of the Defense Production Act for Department of the Interior guarantee of loans, certification of need for loans and purchase, and installation of Government-owned equipment; promote conservation by consuming industries and the public; recommend industry-regulating and consumption-regulating orders for issuance by the Administrator; recommend price policies to the Administrator; and collect and analyze statistics on supply and distribution of resources.

Hugh A. Stewart, Director of the Department's Oil and Gas Division, will handle defense activities in the field of petroleum and gas; Dan H. Wheeler, Assistant Director of the Division of Territories in the Department of the Interior, will handle the field of solid fuels; and James Boyd, Director of the U. S. Bureau of Mines, has been appointed to head the Metals and Minerals Agency.

MINING AND INDUSTRIAL NEWS NOTES

Trinity County Gold Dredge

A dragline dredge is operating on the Trinity River at Honest Bar half a mile below the mouth of the North Fork of the Trinity River. Gravel being worked is 8 to 12 feet deep and lies on a greenstone bedrock. Some of the cobbles are as much as 12 inches in diameter, but there are no large boulders in the gravel. Gravel is dug with a Lima dragline equipped with a $1\frac{1}{2}$ cu. yd. capacity bucket. The washing plant is built on steel pontoons making a barge 36 feet wide, 46 feet long, and 42 inches deep. Sand which passes through the trommel is distributed to sluice boxes fitted with Hungarian riffles located on either side of the trommel. The dredge is owned by V. B. Bennett and associates and was moved to its present location from Canyon Creek. The North Fork Placers operated a hydraulic mine on some inner terraces near Honest Bar in 1939.

New Tungsten Find in Placer County

A new tungsten-bearing district has been located in eastern Placer County on the upper reaches of the Rubicon River 11 airline miles west of Lake Tahoe. Several scheelite-bearing zones in tactite strike northwest across the Rubicon River in the vicinity of Buck Meadow. One zone is believed to cross both Cottonwood and Grayhorse Creeks and extend to Buck Meadow, a distance of about 3 miles. The tactite zones are in limestone roof pendants near their contacts with granitic rocks. One ore body 3 feet wide but with unknown limits, contains coarse-grained scheelite ore averaging about 8 percent WO_3. Other zones contain smaller amounts of finely disseminated scheelite. The tungsten district is partly on land controlled by Pacific Gas and Electric Company and partly on land owned by the Southern Pacific Railroad Company. The Rubicon Mining Company with offices in San Francisco has been organized to explore and develop the ore bodies. As tungsten is on the government list of strategic and critical minerals, development of new deposits would be timely.

MERCURY

Mercury is a heavy, silvery metallic element that is liquid at ordinary temperatures. It has a low vapor pressure and a regular coefficient of expansion. The most familiar uses for mercury are as expanding metal in thermometers and as a weight to balance atmospheric pressure in barometers. Mercury forms alloys, called amalgams, with many metals. The chief demand for mercury today is for the manufacture of chemicals and in industrial control instruments and electrical apparatus.

The United States produces normally about one-seventh of the world's supply of mercury. Italy, Jugoslavia, Mexico, Japan, and Spain are the principal foreign sources. California, through a period of almost 90 years, has been the leader of the mercury-mining industry in the United States; in fact, until 1900 it was practically the only producing state in the Union. From 1850 to 1949, approximately 89 percent of the Nation's mercury was obtained from deposits in California. To date, nearly 2-2/3 million flasks (about 76 pounds each) of mercury valued at approximately $150,000,000 have been produced in the state. The New Almaden and the New Idria mines accounted for 60 percent of this production. In 1949 the U. S. produced 9,880 flasks at an average price of $79.46 per flask.

The most important ore-mineral of mercury is cinnabar, the brilliant red mercury sulfide from which 95 percent of the world's output is obtained. Although there are about 25 known mineral species that contain mercury, only two others, besides cinnabar and a few rare exceptions, occur in commercial quantities: native mercury, which is fairly common; and metacinnabar, the black sulfide, which is the least common of these three ore minerals. All these minerals are commonly associated with marcasite; less frequently with pyrite. Cinnabar is deposited from hot alkaline solutions and may occur as disseminated specks scattered through sandstone or some other porous rock, as irregular bunches and streaks in altered rocks of various kinds, or as breccia and fracture fillings.

Cinnabar is generally massive, earthy, or minutely crystalline, but good crystals occasionally are found. It is distinguished from other red-colored minerals by its high specific gravity, brilliant adamantine luster, and perfect cleavage. Associated with calcite, barite, quartz, chalcedony, and opal as gangue minerals, cinnabar may be found in definite, though usually iregular veins.

The principal mercury ore-deposits of California are found in the Coast Ranges within a northwest-southeast belt, approximately 400 miles long by 75 miles wide, extending from Santa Barbara County on the south to an area above Clear Lake, 100 miles north of San Francisco.

Most of these deposits occur in the fractures of fault zones in igneous rock, especially serpentines, and associated sediments (sandstone, shale, and chert) of the Franciscan formation (Jurassic). Ores are also found in Cretaceous shale and sandstone, as at New Idria. Other scattered deposits include the Cuddeback and Coso mines, where the ore has been introduced into granitic and rhyolitic rocks respectively.

Although the deposits may be found in rocks of various geologic ages, the time of deposition of the ore minerals appears to be quite late -- late Pliocene, Pleistocene, and even Recent. Mercury deposits appear to be related to volcanic activity, and are frequently precipitated from the waters of hot springs and fumaroles. Cinnabar is formed at comparatively shallow depths. The characteristic irregular form of the ore bodies is largely determined by the structure and fracturing of the enclosing rocks. Many of the deposits have flat dips and usually do not extend to any great depth.

The association of mercury deposits with serpentine is structural, not genetic. That is, the fracturing of the serpentine has afforded channels for the passage of ascending solutions to favorable zones of precipitation. Not only is serpentine an alteration of peridotites and pyroxenites, but the occasionally associated so-called "quicksilver rock", or "silica-carbonate rock", is a replacement of altered serpentine by silica and dolomite or calcite. Weathered outcrops are usually iron-stained and may resemble gossan. This peculiar type of gossan was regarded by prospectors as the surface indication of a possible rich mercury deposit beneath it, and in some instances this has been the case.

The tenor of the mercury ores of the world varies over a wide range, as little as 0.15 percent mercury per ton to as high as 5-10 percent. In California, profitable returns have been won from direct furnace reduction of ore averaging from 5 to 10 pounds (0.25-0.5 percent) of mercury per ton.

Mercury is prepared for the primary market, following its extraction from the ore by distillation, and prior to bottling at the mine, simply by removing dust and soot, which float on the surface of the pool of metal in storage.

Bottles, or flasks, for shipping are made of wrought-iron or steel with screw-plug stoppers. Into each flask is poured 76 pounds of mercury; this is the United States unit of weight for marketing of the metal, and upon it price quotations are based.

Mercury is sold either directly to the consumer, or through the agency of a metal broker, or by both means. The net return to the producer varies subject to numerous factors, including broker's commissions, haulage and freight rates, handling and delivery charges, and insurance.

The primary markets for mercury in the United States are San Francisco and New York. Although considerable quantities of mercury are handled by agents and brokers in San Francisco, the greater percentage of produced metal is sold directly in New York. Secondary markets, or markets in which the mercury and its products are sold to consumers, exist in all large cities, and wherever there are chemical supply houses.

The operating cost of producing a flask of mercury depends upon mining costs, treatment costs, grade of ore, and percentage recovery from the ore. This cost for present-day mercury mining in California varies from $30.00 a ton to as much as $100 and more. The price obtained for a flask of mercury is generally based upon New York metal-market quotations, which are usually $5.00 to $6.00 higher than San Francisco prices. The present price of approximately $70 per flask at New York is below the cost of production of most domestic properties. Mercury imported from foreign sources is subject to a tariff duty of $19.00 per flask, but can be profitably sold in the United States because of lower costs of production.

The present demand for mercury has reached a more constant level than heretofore, owing to increased usefulness of the metal; it is now indispensable to many forms of modern electrical, mechanical and chemical industries. In 1949 the United States consumed more than 40,000 flasks of mercury. Approximately 21 percent was used in the manufacture of electrical apparatus, 13 percent in industrial and control instruments, 15 percent in agriculture, 7 percent in catalysts, 10 percent in pharmaceuticals, 2 percent in antifouling paint, and the remainder in dental preparations, munitions, blasting caps, amalgamation, in the manufacture of vermilion paint, the electrolytic preparation of chlorine and caustic soda, and in general laboratory and miscellaneous uses.

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RECENT GIFTS TO THE DIVISION OF MINES LIBRARY

The Division of Mines gratefully acknowledges the gift to its technical library of 27 volumes from the collection of Mr. Emile Huguenin of Inverness. The 23 volumes of A.I.M.E. Transactions and 4 volumes of Oil Development and Production will do much toward completing the library files of these publications.

The San Francisco office library is also pleased to acknowledge receipt of a group of miscellaneous publications on mining and the mineral industry from Mr. E. W. Billeb of San Francisco. The collection included many U. S. Bureau of Mines reports of investigations and revised information circulars.

The Los Angeles branch office library has recently been supplemented by more than 250 publications given by Mr. E. S. Eccleston of Hollywood. The collection is predominantly U. S. Geological Survey bulletins and professional papers and U. S. Bureau of Mines bulletins, reports of investigations, and information circulars, but several rare maps are included. The Division extends thanks to Mr. Eccleston for this fine donation.

CALIFORNIA TOPOGRAPHIC MAPS

The Topographic Mapping Section of the U. S. Geological Survey has announced that the following topographic maps of areas in California recently have become available. Copies may be secured from local distributing agencies or from the U. S. Geological Survey, Denver Federal Center, Denver 15, Colorado, at a cost of 20 cents each.

Location of S. E. Corner				Name	Scale	Contour Interval in Feet
N. Latitude		W. Longitude				
Deg.	Min.	Deg.	Min.			
33	45	117	52½	Anaheim	1:24,000	5
36	22½	119	52½	Burrel	1:24,000	5
36	22½	119	30	Burris Park	1:24,000	5
35	30	119	30	Goose Lake	1:24,000	5
39	37	121	22½	Las Plumas	1:24,000	25
35	22½	119	30	Lokern	1:24,000	5
35	22½	118	52½	Oil Center	1:24,000	5
33	22½	117	00	Pechanga	1:24,000	20
38	37½	120	45	Placerville	1:24,000	40
35	22½	119	07½	Rosedale	1:24,000	5
35	22½	120	52½	Shingle Springs	1:24,000	40
39	30	121	37½	Shippee	1:24,000	5
36	22½	120	07½	Towne Oil St.	1:24,000	5
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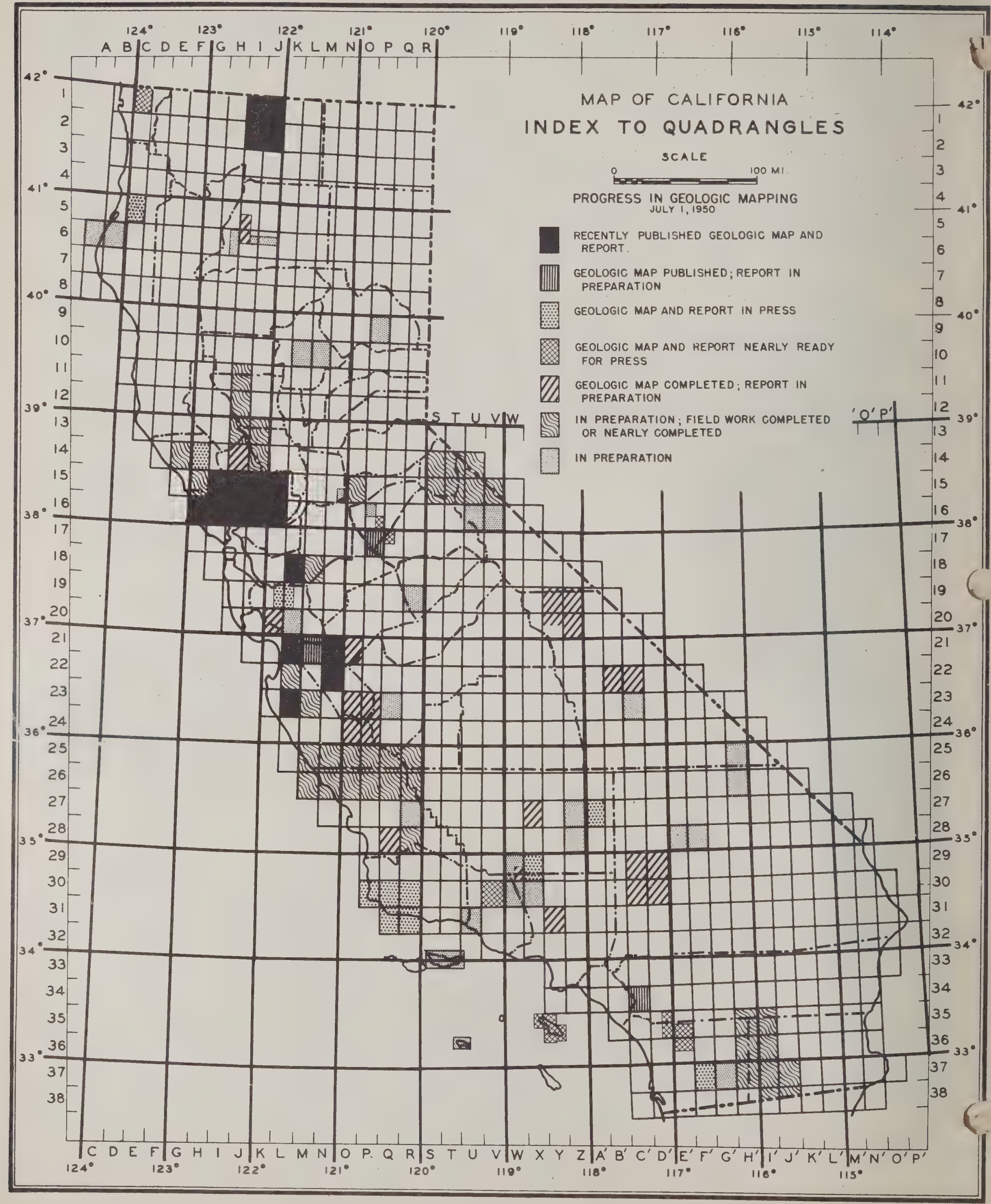
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NEW PUBLICATIONS OF THE DIVISION OF MINES

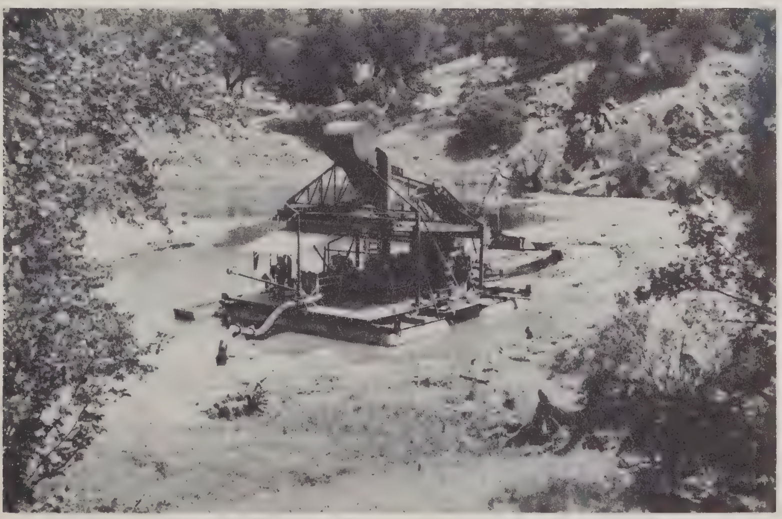
California Journal of Mines and Geology

The October issue of this quarterly (vol. 46, no. 4) is now being distributed. It contains "Mines and Mineral Resources of Madera County" by C. A. Logan; "Mining Law in Recent Years" by William E. Colby; and "Quicksilver Deposits of the Cachuma District, Santa Barbara County, California," by Donald L. Everhart.

Madera County created in 1893 was at different times a part of Mariposa, Merced, and Fresno Counties. It has had a long history of production of gold and in addition has produced significant amounts of pumice and pumicite, copper, miscellaneous stone and various other minerals. Value of these products through 1948 has exceeded sixteen and a half million dollars. The article describes the mineral resources, gives a tabulated list of the mines and prospects in Madera County, and discusses briefly the geology and geography of the county. C. A. Logan, the author, is a retired District Mining Engineer of the Division of Mines.

"Mining Law in Recent Years", the third of a series of articles by that title to appear in the Journal, deals with mineral deposits of swamp and overflowed lands and land grants to the states; also it will be of particular interest because of the many lawsuits which have been tried over deposits of that description in recent years. Mr. Colby is a prominent local authority on mining law and a member of the San Francisco Bar.

Donald L. Everhart's paper on "Quicksilver Deposits of the Cachuma District, Santa Barbara County, California" describes the geology and mineral deposits of a district located 23 miles northeast of the town of Solvang. Detailed descriptions of the two principal mines, the Lion Den and Red Rock, are features, and complete geological information with recommendations for exploration are included. Other prospects and claims are also discussed.



Ten-inch suction dredge of Chowchilla Dredging Company on Chowchilla River, 7 miles north of Raymond, Madera County.

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________ copies of Bulletin 156, Mineral Commodities of California, @ $2.00 .... ______

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MINERAL INFORMATION SERVICE

Vol. 3 December 1, 1950 No. 12

MINERAL INFORMATION SERVICE is a monthly news release concerning the mineral resources and industry of CALIFORNIA, designed to inform the public of the discoveries, operations, markets, statistics, and new publications. It is distributed without cost upon request.

LOANS FOR DEVELOPING STRATEGIC MINERAL DEPOSITS

The provisions of the Defense Production Act which relate to the procedures in certifying strategic mineral deposits for loans and purchase contracts are still being discussed. Until regulations are issued it appears that the U. S. Bureau of Mines will examine property brought to its attention, prepare a report approving or disapproving further exploration or development, and forward to the Reconstruction Finance Corporation its recommendations on the necessity of a loan. Purchase contracts are arranged through the General Services Administration. Proposals involving deposits in California (and Nevada) may be sent to Mr. H. C. Miller, Regional Director, Region III, 555 Battery Street, San Francisco, California.

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MINING LABOR AND THE DRAFT

As there are now not enough miners available to maintain present production levels in the mining industry, any appreciable drafting of manpower from trained mining labor is sure to lower this production. The importance of deferring competent mining labor for the production of minerals and metals has been brought to the attention of draft officials. It may be possible to obtain deferment for a mine worker if it is shown in the application that it would take over two years to train a replacement for the drafted miner; if the training period is less than two years, deferment probably would not be granted and a replacement would have to be made.

CALIFORNIA'S MINERAL POSITION IN A CHANGING INDUSTRIAL WORLD

Abstract of a paper presented by Olaf P. Jenkins before the Industrial Minerals Division of the A.I.M.E. which met in Los Angeles October 13, 1950:

In 1950 the population of California passed the ten million mark, doubling the figures of 1930. In 1948 the annual mineral production figure of the state passed the billion dollar mark, doubling the figure of 1946. This shows the effect of population growth on industry and of industry on mineral exploitation. The minerals which build industry are those that are required by it, for the most part fuels and nonmetallic minerals. The tremendous ability of California's natural resources to meet national crises has been illustrated in two world wars with the production of strategic and critical minerals. The nationwide depression that followed the Civil War was brought to a close by the effect of the gold produced during the early days of California's statehood. A study of the production history of the state's mineral commodities shows only the major trends. The more complicated subject of utilization and specifications, together with industrial growth, has never been fully studied. Putting to use the state's enormous diversified potential mineral resources requires knowledge of industrial uses and specifications as well as knowledge of the occurrence of minerals and the method of extraction. This important subject of mineral economics and markets has been neglected by universities and is seldom recognized as necessary by exploration geologists, mining engineers, and operators. To unleash a mineral wealth in California, in size many times that now produced, is a challenge offered the young mining geologist who is willing to follow this new approach and keep alert in the field for minerals usable in the new industries which are now expanding and crowding our population centers.

CORRECTION FOR STRATEGIC MINERALS TABLES

Readers of Mineral Information Service are requested to substitute the table appearing below for Table I under "Sources of Information on Strategic Minerals" which appeared on page 2 of the October issue of Mineral Information Service. The substitution is important as all entries in column 5 of "Table 2" of the same issue are affected.

GENERAL REFERENCES - STRATEGIC MINERALS - TABLE I

1. American Mining Congress Bull. Service - Bi-weekly pamphlet.
2. Engineering and Mining Jour. Metal and Mineral Markets - weekly pamphlet on marketing.
3. Industrial Minerals and Rocks, 2nd ed., A.I.M.E., 1949.
4. Mineral Commodities of California, Geologic occurrence, economic development and utilization of the state's mineral resources, Calif. Div. Mines Bull. 156, 1950.
5. Mineral Information Service - monthly pamphlet, Calif. Div. Mines.
6. Mineral Resources of the United States, Public Affairs Press, 1948.
7. Minerals in World Affairs, Lovering, T. S., Prentice-Hall Book Co., N. Y., 1943.
8. Minerals Yearbook, U. S. Bur. Mines, 1948. Annual statistical publication.
9. Strategic Mineral Supplies, Roush, G. A., N. Y., McGraw-Hill Book Co., 1947.
10. Strategic Minerals, De Mille, J. B., N. Y., McGraw-Hill Book Co., 1947.
11. Strategic Minerals in California, Merrill, C. W., Calif. Div. Mines Rept. 34, 1938.
12. Stockpile Report to Congress, U. S. Munitions Board, July 1950.
13. Western Economic Empire, Industrial West Foundation, San Francisco, 1944.
14. World Minerals and World Peace, Leith, C. K., et al, Brookings Institution, Washington, D. C., 1943.
15. Economic Geology, Ries, Heinrich et al, 7th ed., John Wiley and Sons, Inc., 1937.

RECENT GIFTS TO THE LOS ANGELES LIBRARY OF THE DIVISION OF MINES

The Los Angeles office of the Division of Mines gratefully acknowledges the gift of about 400 volumes on mining and geological subjects from Mr. Garnett A. Joslin, well-known Los Angeles mining engineer now residing in Mexico City. The collection includes numerous U. S. Geological Survey bulletins and professional papers, U. S. Bureau of Mines bulletins and information circulars, Arizona Bureau of Mines publications, California Division of Mines publications, A. I. M. E. Transactions, and other miscellaneous books and texts. Collections of this kind are of inestimable value in completing Division files and replacing missing or wornout volumes.

MINING AND INDUSTRIAL NEWS NOTES

Cement Operations in the Victorville-Oro Grande District, San Bernardino County

Southwestern Portland Cement Company is extending its railroad from Sidewinder Well to the quarries at Black Mountain. When completed the line will be approximately 15 miles long with pay hauls almost entirely down grade. The company's Black Mountain deposit, recently proven by an extensive diamond drilling program, contains one of the largest continuous proven reserves in California. The deposit is a limestone conglomerate of Permian or Triassic age which is situated in the axis of a tight synclinal fold. The bulk of the limestone lies above local base level, so that pit or underground mining will not be necessary for many years to come. Black Mountain is relatively free of igneous intrusions and of silicated contact zones. In line with its expanded limestone reserves, Southwestern recently added to its plant capacity by installation of a new rotary kiln.

Riverside Cement Company is currently testing and developing its Sparkhule Hill limestone deposits to supplement production from its quarries near Oro Grande. The company has revamped its entire plant and constructed three new 350-foot dry process kilns during the postwar period.

Wildcat Drilling in Colusa County

A new test well, the Nieta Peterson #1, is being drilled in Sec. 6, T 17 N, R 4 W, M. D., on the Sites anticline of north central Colusa County by Mr. L. O. Tarrant. Three wells were drilled at various other points on the structure in the period 1923 to 1927. The gas was nearly pure methane and quantity production of gas of this grade would be welcome even if oil is not found. The Sites anticline is a chevron type of fold having very steep limbs. It lies to the east of a broad syncline. Axes of both structures trend roughly north-south but they are disrupted by several more or less parallel transverse faults which trend northeast. Upper and Lower Cretaceous marine sediments are the only rocks penetrated by the old wells or exposed at the surface, so Cretaceous beds are presumed to be the source of the gas. The Sutter Buttes field, located 25 miles to the southeast, produces gas from Cretaceous beds.

CALIFORNIA TOPOGRAPHIC MAPS

The Topographic Mapping Section of the U. S. Geological Survey has announced that the following topographic maps of California areas recently have become available in final form. Copies may be secured from local distributing agencies or from the U. S. Geological Survey, Denver Federal Center, Denver 15, Colorado, at a cost of 20¢ each.

Location of Southeast Corner						
Latitude		Longitude		Name	Contour Interval in Feet	Scale
Deg.	Min.	Deg.	Min.			
39	30	121	15	Forbestown	25	1:24,000
38	45	120	45	Garden Valley	40	1:24,000
38	52½	120	52½	Greenwood	40	1:24,000
39	00	121	07½	Lake Combie	20	1:24,000
37	45	122	22½	San Francisco North	25	1:24,000
33	37½	118	00	Seal Beach	5	1:24,000
39	00	121	07½	Wolf	20	1:24,000

Advance Prints

Advance prints are black or blue line ozalids prepared by the Survey for final checking and editing purposes. Copies may be secured at a cost of 50¢ each by addressing the Pacific Region Engineer, Topographic Branch, U. S. Geological Survey, Box 346, Sacramento

California. Please notice that payment in exact amount by check, money order, or draft should accompany orders for advance prints; cash or postage stamps will not be accepted. Make remittances payable to the Treasurer of the United States.

Location of Southeast Corner						
Latitude		Longitude		Name	Contour Interval in Feet	Scale
Deg.	Min.	Deg.	Min.			
39	27½	121	00	American House	25	1:24,000
33	45	117	37½	Black Star Canyon	20	1:24,000
39	22½	121	00	Camptonville	25	1:24,000
39	37½	121	07½	Cascade	25	1:24,000
39	22½	121	07½	Challenge	25	1:24,000
39	30	121	07½	Clipper Mill	25	1:24,000
39	00	120	52½	Colfax	40	1:24,000
33	37½	117	37½	El Toro	20	1:24,000
38	07½	122	00	Fairfield	20	1:24,000
39	00	120	45	Forest Hill	40	1:24,000
39	15	121	07½	French Corral	25	1:24,000
38	52½	120	45	Georgetown	40	1:24,000
39	07½	121	00	Grass Valley	20	1:24,000
39	37½	122	00	Hamilton City	5	1:24,000
39	45	127	07½	Kirkwood	5	1:24,000
33	45	118	00	Los Alamitos	5	1:24,000
33	22½	117	22½	Margarita Peak	20	1:24,000
33	37½	117	52½	Newport Beach	5	1:24,000
33	45	117	45	Orange	20	1:24,000
33	15	116	45	Palomar Observatory	40	1:24,000
34	00	114	15	Parker	40	1:62,500
34	00	119	00	Pt. Mugu	20	1:24,000
33	52½	117	37½	Prado Dam	25	1:24,000
36	30	119	22½	Reedley	5	1:24,000
39	30	121	00	Strawberry Valley	25	1:24,000
36	30	119	15	Sultana	5-25	1:24,000
35	45	117	15	Trona	40	1:62,500
34	00	114	30	Vidal	20	1:62,500
33	52½	117	45	Yorba Linda (Olinda)	25	1:24,000

SALT, SODA ASH, AND SALT CAKE

As a great many sodium compounds are highly soluble in water, they tend to become concentrated in sea water and in lakes which have no outlets. Consequently, the chief natural sources of sodium chemicals are marine and salt-lake brines or sedimentary beds formed by evaporation of such brines. Rock salt deposits supply most of the common salt produced in the United States, but 90 percent of California's output is obtained by solar evaporation of sea water.

Sodium salts are produced from brines by fractional crystallization under closely controlled conditions of temperature, pressure, and brine concentration. Different compounds crystallize out under different physico-chemical conditions, but crystallizing properties of some minerals are so nearly alike that close controls are necessary to produce pure products.

Sodium Chloride

Halite, the natural sodium chloride, most commonly crystallizes as cubes or in granular masses. The mineral is white or colorless when pure but traces of impurities make it yellowish, brownish, or purplish. It is translucent to transparent, with a vitreous luster.

California is one of the few places in the United States where proximity to markets, a dry climate with high evaporation, and land suitable for the construction of evaporating ponds are combined to make the historic solar-evaporation process for extracting salt from the sea still economically feasible. Small quantities of salt have also been obtained by solar-evaporation of natural brines other than sea water and by evaporation of brines in desert basins.

Salt is the principal raw material from which sodium and chlorine products are made. Sixty percent of the salt produced in the United States is used in unrefined form by the chemical industry. Uses requiring semi-refined salt consume 20 percent of the national output. These include the packing of meat and fish, the processing of vegetable oils, the salting of hides, dust and ice control on highways and railways, and refrigeration. The remainder of the salt produced is highly refined for human consumption. The production of salt in the United States has exceeded 15,000,000 short tons annually for the past seven years. California produced more than 800,000 tons during 1947.

There is a wide range between the value of crude salt and the prices of refined products. In California the average value of crude salt was $3.00 per ton f.o.b. plant in 1949. A recent quotation for rock salt in carload lots was 94¢ per hundredweight at the factory. Vacuum salt, or salt which is refined to a high degree of purity, averages slightly higher in price than rock salt.

Sodium Carbonate

More than 90 percent of natural sodium carbonate produced in the United States comes from California. Natural sodium carbonate compounds comprise only about 5 percent of domestic production; the remainder is manufactured from common salt. Sodium carbonate compounds of commerce include soda ash (Na_2CO_3) of various grades, sal soda ($Na_2CO_3.10H_2O$), the monohydrate ($Na_2CO_3.H_2O$) and sodium bicarbonate ($NaHCO_3$).

Sodium carbonate, one of the saline minerals, is found in the brines of certain springs and saline lakes and as deposits in playa lake beds. Trona ($Na_2CO_3.NaHCO_3.2H_2O$), the most common sodium carbonate mineral, is a very soluble, gray or yellowish translucent mineral which occurs in fibrous or columnar masses or, less commonly, in cleavable plates. Natron ($Na_2CO_3.10H_2O$) is a soft mineral which readily dehydrates on exposure to dry air. Other less common sodium carbonate minerals are hanksite ($9Na_2SO_4.2Na_2CO_3.KCl$), burkeite ($2Na_2SO_4.Na_2CO_3$), thermonatrite ($Na_2CO_3.H_2O$) and nahcolite ($NaHCO_3$). They are all soft, have a low specific gravity, 1.5 to 2.4, and are soluble in water.

All of the sodium carbonate produced in California is obtained by five plants located on the shores of Owens and Searles Lakes. These plants process deposits formed by solar evaporation of saline lake water. Similar deposits are forming today in playas in the deserts of southeastern California. Enormous untouched reserves exist in Death Valley and Deep Springs, Inyo County; Alkali Lake, Mono County; Annie Lake, Modoc County; Honey Lake, Lassen County; and Soda Lake, San Bernardino County.

Soda ash is consumed chiefly by the glass, ceramic and soap industries and by manufacturers of caustic soda and other sodium chemicals. Smaller amounts are used to manufacture paper pulp, water softeners, textiles, and cleansers, and in nonferrous metallurgy and petroleum refining.

Soda ash with a 58 percent Na_2O commonly is sold in one-hundred pound paper bags. A recent price quotation for light calcined soda ash in carload lots at the chemical works was $1.50 per hundredweight. The price of natural soda is probably lower.

Sodium Sulfate

Salt cake is crude anhydrous sodium sulfate containing 92 to 99 percent Na_2SO_4. The name is also applied to deposits of the mineral thenardite (Na_2SO_4). Other sodium sulfate compounds of commerce include glauber's salt ($Na_2SO_4.10H_2O$) and niter cake ($NaHSO_4$). California contributes about 80 percent of the total natural sodium sulfate produced in the United States. Less than 25 percent of the national consumption, however, is of the natural material.

Glauber's salt or mirabilite forms needle-like crystals resembling the pyroxenes in shape. It generally occurs as crusts or efflorescences. It is a soft, transparent or opaque, white mineral with a vitreous luster. It is quite soluble in warm water but much less so in cold water. When exposed to dry air, it loses its water of crystallization and crumbles to a fine powder.

Thenardite is a white or brownish mineral which forms both euhedral crystals and crystalline masses. It is highly soluble in water. Thenardite is precipitated from a brine containing sodium sulfate when the brine is evaporated at temperatures above 32.38°C.

In November 1950, the price at the chemical plant of salt cake (100 percent Na_2SO_4 basis) was $17 a short ton, anhydrous sodium sulfate $2.00 a hundredweight, and glauber's salt $45 a short ton. Natural sodium sulfate usually sells for somewhat less.

Sodium sulfate is one of the important industrial chemicals. The manufacture of kraft paper, glass, and chemicals consume most of the output of the natural product; other uses are in metallurgy, in stock feed, and in detergents.

Prospecting for Saline Minerals

Lands known to contain sodium salts (except common salt, on which one claim only may be located) cannot be located or patented under the lode or placer laws but are obtainable under lease, subject to the regulations and control of the Secretary of the Interior. The possessory right to a location made prior to the passage of the "Leasing Act" in 1920 is not disturbed by its provisions. Applications for permits to prospect for sodium compounds may be obtained from the local office of the United States Bureau of Land Management.

REFERENCE LIST OF RECENT PUBLICATIONS

The following references are available for study in the library of the Division of Mines at San Francisco, but are not for sale by the Division.

Baldwin, Thomas A., San Ardo -- a stratigraphic analysis of a California oil field: Am. Assoc. Petroleum Geologists Bull., vol. 34, no. 10, pp. 1981-89, October 1950.

Clark, John D., Petalite, a new commercial mineral: Mining Engineering, vol. 187, no. 10, pp. 1068-70, October 1950. Petalite is a lithium aluminum silicate mineral which is becoming increasingly useful in "heat shock" ceramic bodies.

Connell, G. A., Operations of Pacific Coast Borax Co. -- paper presented before October 1950 meeting of A.I.M.E. Industrial Minerals Division, Los Angeles Section, 6 pp. Includes history of operations, classification of borate minerals, distribution of minerals and description of California deposits and operations.

Girwin, C. W., and Witmer, E. B., The production of iodine in the United States. Paper presented before October 1950 meeting of A.I.M.E., Industrial Minerals Division, Los Angeles Section, 3 pp. Discusses the California occurrences which supply all of U. S. output of iodine.

Lenhart, Walter B., Processing perlite ore for controlled expansion: Rock Products, vol. 53, no. 10, pp. 98-100, October 1950. Describes Combined Metals Reduction Company operation at Castleton, Nevada.

Merrill, W. C., and others, Mineralogical studies of California oil-bearing formations, I Role of Clays - methods of analysis. Paper presented before October meeting of A.I.M.E., Industrial Minerals Division, Los Angeles Section, 9 pp.

Nahin, R. G., and Crog, R. S., Mineralogical studies of California oil-bearing formations -- II Role of Clays -- analysis of natural cores. Paper presented before October meeting A.I.M.E., Industrial Minerals Division, Los Angeles Section, 5 pp.

Ryan, J. E., Searles Lake and operations of the American Potash and Chemical Corporation at Trona, Calif. Presented before October meeting of A.I.M.E., Industrial Minerals Division, Los Angeles Section, 16 pp. Discusses the geologic history of the lake and describes the salt deposits and development operations.

South Coastal Basin investigation including San Jacinto and Antelope Valleys: California Dept. Public Works, Bull. 39 P., 116 pp., 1950. Gives 1947 groundwater levels in wells and precipitation records 1946-47.

Van Wingen, N., Characteristics of clays found in California oil sands: Jour. Petroleum Tech., vol. 2, no. 10, p. 11, sec. 1, October 1950. Discusses changes of clay minerals in accordance with changes in their environment.

Weeks, L. G., Concerning estimates of potential oil reserves: Am. Assoc. Petroleum Geologists Bull., vol. 34, pp. 1947-1953, no. 10, October 1950. Discusses difficulties in estimating ultimate oil reserves and gives revised data on reserves.

RECENT ADDITIONS TO THE SAN FRANCISCO LIBRARY OF THE DIVISION OF MINES

International Nickel Company kindly has made available to the Division of Mines lending library its fine film, "Man Made Canyon", which deals with the great nickel-mining operation at Sudbury, Ontario, Canada. It is a 16mm. black and white film, showing time 20 minutes. The film is available to responsible organizations without charge upon request. Bookings should be made well in advance of the desired date.

The Division of Mines is also happy to acknowledge receipt of several books and magazines on California and Oregon geology and mineral deposits from Mrs. Bonita Barrows of Oakland, California. Several scarce out-of-print volumes were in the collection.

GEOLOGY OF PART OF THE DELTA-MENDOTA CANAL

Special Report 2, Geology of part of the Delta-Mendota Canal near Tracy, California, by Parry Reiche, is now available. This is the first of a new Special Report series to be issued by the Division of Mines. The report summarizes the geology of an 8-mile strip along the western margin of the Great Valley, and discusses the engineering applications of the geology.

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